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EXPORT AND IMPORT TRADE.

The figures which we publish elsewhere in this issue as to the course of trade are encouraging as to the continuing prosperity of the United States and the improving outlook as to larger international commercial relations. It is to be remembered that as to iron and steel, the export of which has grown notably, the home demand has become so great as to lead to rather heavy imports, but this in turn has bettered the conditions abroad. Germany appears happily to be in better shape financially and industrially, and from this time on is certain to mend. As the reception to Prince Henry showed, there is no good reason why the political and trade relationships of the two countries should not improve. In England, too, there is a more cheerful feeling, and it is to be devoutly hoped that the wretched Boer war may soon be allowed to come to a close, not alone for the sake of those on the spot, but, more selfishly, for the great interests of the civilized world.

It is a noticeable fact that with the steadiness in exports there has gone a remarkable growth in the import of manufacturers' materials, the gain being not so much in values as in quantity. The expansion of American manufacturing would seem to require a larger and larger supply of material to be worked up, not available from domestic sources; and herein at least is one means of keeping even the balance of trade, for such extraordinary lopsided balance sheets of international trade as have been exhibited during the past few years could not go on indefinitely, nor could they be wholly beneficial.

WIRELESS TELEPHONY.

In this issue we print two interesting articles on wireless telephony, one by Mr. A. Frederick Collins, and the first section of another by M. Guarini. Mr. Collins' article divides systems of wireless telephony into five classes; but up to the present time none has assumed more than experimental importance. Wireless telephony is, in a certain sense, very prevalent, and, in fact, objectionably prevalent; since inductive cross-talk from one circuit to another, is wireless telephony carried on through the air between the two circuits considered. The difficulties that beset wireless telephony are considerably greater than those which wireless telegraphy encounters. This is essentially for the reason that any kind of an impulse will serve for a telegraph signal, but, for telephony, a sequence of alternating currents, corresponding more or less closely in amplitude, phase and frequency with the vocal vibrations of the speaker, must be retained. All effective vocal frequencies are very low by comparison with the frequencies of emission of wireless telegraph waves. There is, however, always the possibility of finding some indirect means of attaining the result when the direct means is denied. Occasionally the window is a more convenient means of access than the door.

It would be interesting to learn from Mr. Collins what particular apparatus and connections he employed, by which he has been able faintly to reproduce speech wirelessly to a distance of three miles. It is to be hoped that he will describe the conditions at the proper time. While, of course, it would be very nice to have a practicable and convenient system of wireless telephony between ships at sea, yet it is at present of greater importance to develop the system of wireless telegraphy, which seems more likely to give long-range communication than wireless telephony. Long range communication at sea is the important consideration. Fast steamers may now approach

each other so rapidly in a fog, that at least twenty-mile range of communication should be possible in order to avert the danger of collision, when no direct means exists for mutual orientation. Some little preliminary time must be consumed in finding out the mutual whereabouts of the two vessels, and a short range of communication might be of little more service than a fog-bell.

The Wireless Telegraph Situation.

Things are getting a bit lively in etheric circles just now and interesting developments may be looked for. First in point of importance comes the mass of cumulative evidence that has made it reasonably certain that transatlantic signals are within a measurable distance of practical application. Aside from the corroborative experiments made in the last month or two, the attitude of the cable companies is sufficient evidence that they have no serious doubts of the reality of the results. The principal center of disbelief seems to be France, where they still seem to discredit all the evidence and regard the whole matter as an audacious fake for advertising purposes. The keen Gallic mind is prone to question the achievements of foreigners, but we fancy that a little further experience will afford convincing evidence of the reality, even in Paris. The subject, however, has now so far outgrown that kind of skepticism that the more serious features of wireless telegraphy bid fair to become a source of international difficulties. The German Emperor seems to have put his hand to the wheel in favor of the Slaby-Arco system for military and naval use, and Marconi has firmly intrenched himself elsewhere. Naturally the latter does not relish a rival in the field, and his stations will not (if they can help it) receive signals from the Teutonic aggregation. With two actual and *n* potential wireless systems in the field, each with a transatlantic working radius, we are liable to have wire tapping carried out on broad cosmic lines that quite put to shame the finest efforts of the pool-room sharps.

Of course, syntonic work is the plausible remedy, and if it can be successfully carried out would prevent for the most part at least accidental clashing of the etheric legions. As to whether it can be worked successfully there seems to be a radical difference of opinion. Marconi naturally says that his system can be rendered perfectly syntonic. Doubtless it can be in the laboratory, but plausible as the tuning scheme is, and frequently as it has been suggested, it has never yet accomplished anything on a material scale, so that its capabilities are unproved. For instance, it is far from certain that at extreme long range all frequencies will be feasible or possible, and if it should prove that under certain circumstances the range of frequency should be very limited, the chance of interference between rival stations would become certainty. In this connection it is interesting to note the recent reports of Marconi's Cape Breton station, about to be constructed. It is stated that Marconi, having raised the objection that flashes from the trolleys of electric cars would disturb his apparatus, the local authorities have guaranteed him against the near approach of these enemies for a term of years. If Marconi has developed, as he has been quoted as stating, a complete syntonic system, the precaution just noted would seem entirely superfluous. Either, then, the syntonic feature belongs to the future rather than the present—to hope rather than to actuality—or as an alternative very simple electrical disturbances can by design or even by accident cover a range of frequency that will insure interference. Whatever the facts about syntonic operation may be, we think the last suggestion is a most serious one. Whatever frequency may be chosen for syntonic operation, that frequency can be reached with fatal effect by the simple process of feeling for it. One might receive from across the street Morse sent on a given piano key, but what would be the chance of getting the message if a chap in the next room persisted in running scales *fortissimo*.

Even, therefore, granting the practicability of perfectly syntonized apparatus, it may be regarded as certain as anything can be in this world that messages could be wilfully at least interrupted in a very simple manner. Or merely suppose that an experimental station here in New York were sending impulses from apparatus intended to produce heterogeneous waves. If proper conditions for operation permit only a moderate choice of frequency to ensure sensitiveness at long range, then it would be highly probable that every syntonized station within reach would catch it often enough to render steady work hopeless. There is certainly no law against experimenting on wireless telegraphy by any one who pleases, in spite of the patents of Marconi or anybody else, and the air is one of the few things that is common property in this age of trusts. Even putting aside purely casual interference, the necessities of future war will assuredly call for the demoralization of the enemy's wireless telegraph system in the most thorough fashion possible, and Marconi's latest work indicates that the entire terrestrial orb can be set a quiver with an incoherent jumble of signals. It is a delightful prospect for an etheric row if Marconi and the Germans fall out and undertake to fight out the issue of atmospheric supremacy with their own natural weapons. But, joking aside, wireless telegraphy is near enough to commercial operation to give these questions of mutual relations no insignificant place in the public eye. It seems a long and dubious step from the quiet and privacy of the cables buried furlongs deep under the green water in the dark ooze of the ocean bottom, to circles of vibrant ether darted across a hemisphere from throbbing coils at a dozen warring stations, but the step is near at hand for good or ill, and the next few years will see the battle on.

Telephone Rates.

The meeting last week of the American Institute of Electrical Engineers was devoted to this subject. It is a good matter for discussion, has important technical and sociological bearings, and no criticism can properly be directed to such a subject considered on its own basis. It is, however, only one phase of the vast subject of telephony, considered from the standpoint of electrical engineering. It is significant of the unfortunate conditions at present surrounding telephone engineering, that on an evening specially devoted to telephony, the A. I. E. E. had before it, for discussion, papers chiefly relating to telephone rates. The same golden silence has enshrouded the development of electric telephone engineering in this country for many years, during which telephony has been a rapidly advancing art.

A great deal of excellent electrical engineering has been, and is being, accomplished in telephony, and yet but little finds its way into the records of technical literature. This appears to be an artificial consequence of a regularly pursued business policy on the part of the managers of telephone property. It is a deplorable policy, however, which is prejudicial to the best interests of the public, the technical world, and the property owners themselves. It is natural that any corporation which has carried out a long series of expensive experiments should seek to secure the exclusive benefit of the results to which the expenditure has led. There must be, in every business, some details that are properly withheld from publication. When, however, the same reticence is extended to matters of engineering which essentially lie within public purview, the reticence is neither justifiable nor profitable. It is a matter of ordinary observation that in this age of analysis, machinery, and the methods of its operation, cannot be withheld from the scrutiny of the curious. It is said that for six centuries the secret of manufacturing Greek-fire for use in naval warfare was jealously and successfully guarded in the arsenal of Constantinople. A few industrial chemical secrets are successfully preserved to-day; but no telephone apparatus or system which goes into the hands of the public can be sealed from investigation, when sufficient intelligent effort is directed to unravelling it. Consequently, all

engineering matters which cannot, by their nature, be concealed, should be clearly described, and all achievements recorded. Indiscriminate concealment is morally wrong, for it opposes civilization and progress, and the results of such a policy must inevitably work for retribution. Fortunately, each year sees improvement in this direction, and telephone engineering is finding its way gradually into public notice.

Mr. Abbott's paper contains some interesting statistics for the telephonic conditions in 21 large cities of the United States. Assuming these to be reliable, it appears that, in the large cities, on the average, one person, or unit of population, in thirty, has a telephone, so that the total number of telephone subscribers in a city multiplied by 30 should give a rough idea of the population of that city. Also, the average length of wire per telephone in the cities is about 2.2 miles. Rather more than three-quarters of all the wire in the cities is already underground. The flat rates range from $40 to $240 per annum for business telephones and from $24 to $100 per annum for residence telephones, the independent companies, where installed, being generally markedly the cheaper. For single-party measured service and one thousand calls annually, the range is from $41 to $99 in business houses and from $33 to $90 in residences. Mr. Abbott points out that, theoretically, an equitable charge should include three items, namely, (1) a flat rate, or minimum, to cover the fixed charges, and in return for the potentiality of being able to talk by telephone with all other subscribers; (2) a charge depending on the number of calls per month, and (3) a charge depending on the total time occupied in talking per month, and as an offset to the extra expense of the company in having the telephone wires engaged. The existing service-rates include the first two items, and the third item is a refinement of the service-rate that may or may not, in the opinion of different managers, be worthy of the extra cost of metering and billing.

As the final result of all inquiry on the subject of rates, it would appear, that partly through improvements in manufacture and operation, partly through service-rates, and partly through competition, the rates of telephoning have steadily fallen throughout the country, although in particular cities little or no change has occurred. Although improvements in apparatus and operation tend to reduce the cost of telephoning, yet, unfortunately, beyond a certain limit, the increase in the number of subscribers tends to increase that cost, so that the problem of economically bringing the telephone into every house becomes very difficult. Faith in the future, however, warrants the belief that at no very remote period every household but the poorest will have a telephone, with a corresponding change in ratio of telephones to population from 3 per cent to, say, 13 per cent.

Lord Kelvin and the Electron Theory.

Lord Kelvin contributes to the March number of the *Philosophical Magazine* a paper on the electron theory, of which a fairly complete abstract may be found in last week's Digest. It is most instructive to see how neatly the modern hypothesis may be twisted into a ludicrously complete confirmation of the venerable theories of Aepinus. It is a metaphysical doctrine sometimes set forth that thought swings in great slow cycles, the learning of one æon becoming the ignorance of a second, and the brilliant speculation of a third. Lucretius advanced much of the modern atomic theory hard upon two thousand years ago, and Omar Khayyam proposed a calendar even simpler and more precise than the one now current. The one-fluid theory has spanned fewer centuries than these, but it has been more fortunate in its champions. And so the cycles recur. There is already evidence of the recrudescence of the emission theory of light, and it would not in the least surprise us to see within the next year or two the whole wave hypothesis openly attacked. The late Prof. Rowland used often to exclaim: "Who will be the Kepler of the molecule?" We do not know, but we feel reasonably certain that he has not yet appeared. We are far from desiring to cross swords with so doughty a leader as Lord Kelvin, but we earnestly wish that the next man who invokes an electrically charged atom electron or electrion to explain physical phenomena, would kindly preface his hypothesis with a definite and consistent explanation of what he connotes by the expression "'electric charge." If half the energy had been spent in the last few years in investigating the dynamics of electrical stresses that has been put upon hypothesis derived from them, we would know more about the constitution of matter. At the present the electron needs explanation just as badly as the atom or the molecule, and the whole subject is open to the charge that it is degenerating into metaphysics.

The Third-Rail System.

We are in frequent receipt of inquiries—most often from newspaper writers and those who strive to be learned in all new developments in every branch of human activity—regarding the literature of the third-rail system, well-known to be the latest marvel in electrical development. This class of seekers for information is distantly related to another whose members appeal to the editor for information on the best and cheapest books on the digging of pole holes, on the operation of rheostats, on the reading of wattmeters and other similarly comprehensive and recondite subjects. The third-rail seeker for information is, however, peculiar in that when baffled in his efforts to sound the profundity of the latest triumph of electricity, he is apt to ascribe his non-success to the jealousy of the technician striving to retain a monopoly of esoteric knowledge. To intimate to him that we are as helpless as if asked to quote the title of a four-volume treatise on snakes in Ireland, merely accentuates suspicion. As reparation to those who feel they have reason for displeasure at our non-responsiveness in the past, and as a reference for future inquirers, we give below, so far as pending patents and commercial considerations will permit, a statement of the more salient features and the present status of the third-rail system:

Much has been learned of the third-rail microbe from biological investigation, a check book being the favorite culture medium. It is apparently closely allied with the *bacillus tetanus*, as the experimenters frequently suffer from a peculiar variety of lock-jaw which incapacitates them from talking about the matter under consideration. There are great and irreconcilable differences of opinion regarding it among those least competent to judge, some upholding the thesis that it is in solidified form, the universal solvent of the alchemists, others as firmly maintaining that it is merely an attempt to realize the doctrine of limits by determinng the least distance at which two conductors can be placed without becoming identical. We can hardly do more than to advise those desiring to study the subject to interview those who have had experience and then to guess at the facts. If an ornate and vividly colored monograph on its profane history is desired, the seekers might interview the directors of the New York Central after taking out accident insurance. Telephoning would be safer, but as the police regulations would prevent anything like a full expression of their views, a call had better be made in person. As to experimental methods, we can give somewhat fuller information. It was found by an investigator in Boston that a bundle of brass curtain rods dropped across the rails was redistributed in a highly interesting manner. Steel car gates and crowbars may also be used for this experiment. Some of our bucolic citizens maintain that the right of way of a third-rail line makes a profitable cow-pasture, but other rural authorities hold that the lessened receipts from dog licenses will more than offset this economic advantage. Finally, as to the difference between the third rail and trolley systems, some claim it is greater and some less than the difference between tweedle-dee and tweedle-dum.

The Independent Telephone Convention at Chicago.

We are indebted to Mr. J. J. Nate, of Chicago, member of the committee for organizing the Interstate Telephone Association Convention, which will be held at the Sherman House, Chicago, on April 9, 10 and 11, for the following data in regard to that interesting event:

"Arrangements have been completed whereby railroad fares can be secured on a certificate plan at 1⅓ fare for the round trip. This concession has been granted from all points in Iowa, Wisconsin, Michigan, Indiana, Kentucky, Missouri and Illinois. Visitors and delegates when purchasing their tickets should call for a rebate certificate. This certificate must be presented at the committee's headquarters, Parlor "A," Sherman House, on the 10th day of April, for the signature of the proper official appointed by the Passenger Associations for the purpose.

"From acceptances thus far received in reply to invitations mailed, this telephone convention promises to be the most successful and largest ever held. An elaborate program has been prepared, and the speakers who will read papers or address the convention are some of the best informed men in the telephone field. Invitations have also been accepted by other prominent and well known men, who will address the convention on the occasion of its gathering."

Electrical Engineers of the Day—XL.

J. J. CARTY.

John J. Carty was born at Cambridge, Mass., April 14, 1861. His early education was obtained in the schools of his native city. At the time he had about finished his preparatory studies for entrance to college, he was obliged, on account of a serious trouble with his eyesight, to abandon his school work indefinitely.

The telephone having recently been invented, Mr. Carty entered the service of the Bell Telphone Company, for which concern in some of its various interests he has been at work ever since, having to his credit 22 years of continuous service in its behalf in the active development of the art of telephony, at the present time being chief engineer of the New York Telephone Company.

His first work was with the Telephone Despatch Company at Boston, and while there he made a number of contributions to the art of telephony which were of unusual value and have since become a permanent part of the art. Under his direction was installed the first multiple switchboard at Boston, which was at that time the largest ever put into use. For the "express" telephone system peculiar to that city he designed and installed a switchboard which was the first metallic circuit multiple board to go into service. Some of the fundamental features of this board are present in all of the boards of to-day.

In 1887 Mr. Carty took charge of the cable department of the Western Electric Company in the East, with headquarters at New York. In this capacity he studied cable manufacture and laying, and introduced a number of improvements, having charge of all the important cable-laying projects which were carried on for some time in the eastern cities. He then took charge of the switchboard department of the Western Electric Company for the East, and under his direction were installed most of the large switchboards of that period, among which was the original Cortlandt Street multiple board. During this time he made a number of important improvements in switchboards which have since become standard practice.

He was the first to practically demonstrate how to operate two or more telephone circuits connected directly with a common battery, and about 1888 installed for the supply of operators' telephones, common battery systems in a number of central offices. From these early experiments have grown the standard common battery systems now generally employed.

Although charged with serious practical engineering problems, Mr. Carty has found time to follow to some extent his strong natural inclination for original research. He made an exhaustive investigation into the nature of the disturbances to which telephone lines are subjected and gave the first public account of his work in a paper entitled "A New View of Telephone Induction," read before the Electric Club on Nov. 21, 1889. The view put forth in the paper was revolutionary, but, nevertheless, after being checked by numbers of experimenters in this country and Europe, received universal acceptance, and is the one now adopted in all works dealing with the subject. In this paper he showed the overwhelming preponderance of electrostatic induction as a factor in producing cross talk, and proved that there is in a telephone line a particular point in the circuit at which, if a telephone is inserted, no cross-talk will be heard. The paper also gave directions for determining this silent or neutral point, and described original experiments showing how to distinguish between electrostatic and electromagnetic induction in telephone lines.

On March 17, 1891, Mr. Carty made additional contributions to the knowledge of this subject in a paper before the American Institute of Electrical Engineers entitled, "Inductive Disturbances in Telephone Circuits." This paper might better have been called "The Theory of Transpositions," because in it for the first time was made known precisely why it is that twisting or transposing telephone lines renders them free from inductive disturbances.

In 1889 he entered the service of the Metropolitan Telephone & Telegraph Company, now the New York Telephone Company, for the purpose of organizing all of the technical departments, building up its staff, and reconstructing the entire plant of the company—converting it from grounded circuits overhead and series switchboards, to metallic circuits placed underground and to the then new bridging switchboards. In carrying out this work, he selected and trained a large staff of young men fresh from college, many of whom have since attained positions of prominence in the telephone field. In the development of the personnel of his department, Mr. Carty has taken a particular pride, looking to the welfare of those already

engaged, and through his touch with prominent technical educators, adding each year to his staff from the graduating classes of our principal technical schools.

Mr. Carty's more recent work has been in connection with the reconstruction of the New York Telephone Company's plant the second time, converting it from cables and switchboards of the old type to modern cables and the common-battery switchboard, and providing for the extraordinary extensions which to-day constitute the comprehensive telephone system of New York.

Mr. Carty has been granted a number of patents, some of them fundamental in their character, of which perhaps the most important is that known as the Carty bridging bell patent. No more sudden and complete revolution in any part of the telephone art can be found than that which followed his address at the Detroit Telephone Convention in 1890 on the subject of bridging bells. From the day the address was delivered telephone engineers throughout the country began the work of removing series bells and replacing them with those of the bridging type. The improvement which this wrought in telephone service on party lines has not been exceeded by any other single advance in the art.

Mr. Carty is one of the Board of Managers of the American Institute of Electrical Engineers, a member of the Society of Arts and of the New York Electrical Society. He is an honorary member of the American Electro-Therapeutic Society, to which position he was elected as a recognition of his valuable work in the direction of more rational methods in the use of electrical currents in medicine.

A New Telephone Exchange in London.

THE Britilsh National Telephone Company has recently completed an exchange at Battersea, London, which presents several features of interest to American readers. While it was designed in conformity with American practice, it does not follow throughout any particular system, and some features have been added suggested by local experience. The lamp signal board works on the Kellogg central battery system, and is the only one of its kind in Europe. The central battery system, while along the lines of that known abroad as the Western Electric system, yet departs from it in several particulars.

The operating on the subscribers' positions is similar to the Western Electric Company's system. The calling lamp is actuated by the subscriber removing his telephone from the switch hook. There are two clearing lamps in front of each pair of cords, the front one actuated by the called subscriber hanging up his telephone, and the back one by the calling subscriber doing a similar action. The operator does not withdraw the plugs from the jacks until both lamps are alight.

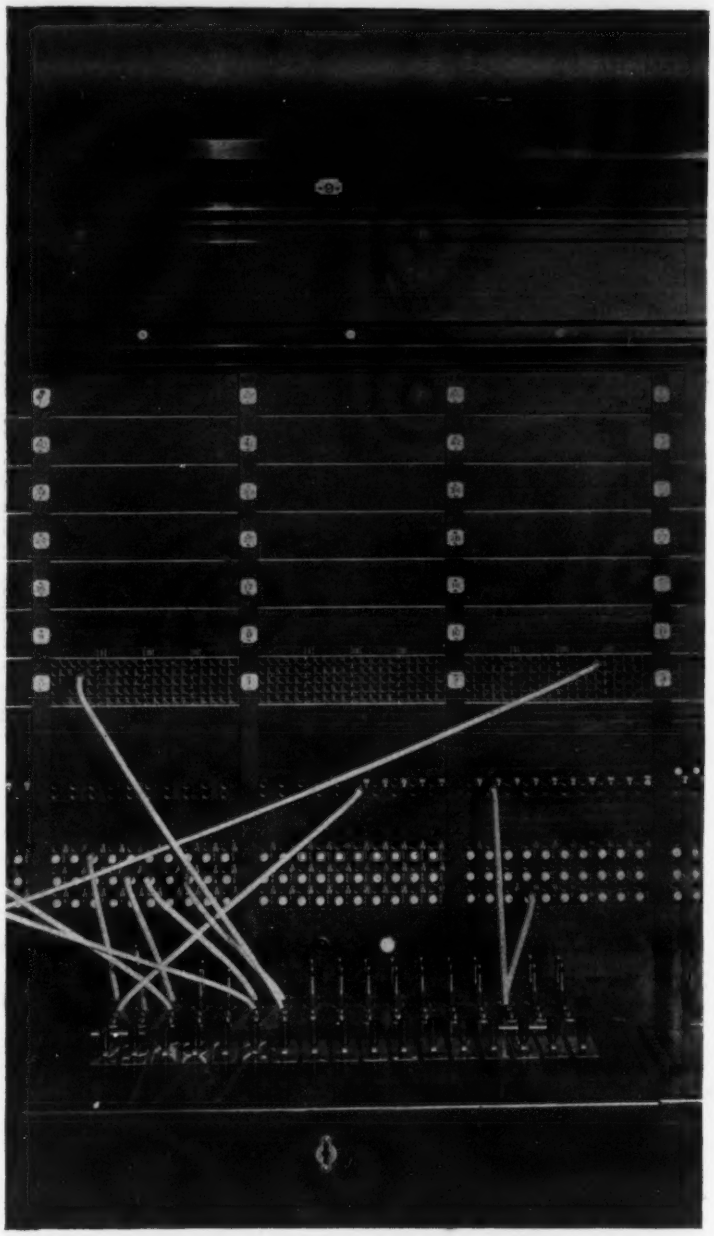


FIG. 1.—MULTIPLE PANELS AND PLUG AND KEY SHELF.

Fig 1 shows the multiple panels and key shelf of one operator's position. Conforming to the usual practice for modern switchboards, each section is arranged for three operators, there being at present 65 subscribers allocated to each operator. This number will in all probability shortly be increased to 80, and could, if advisable, easily be increased to double that number. The subscribers' local jacks and calling lamps are placed at the bottom of the multiple panels, above these the outgoing junction jacks and above these the multiple jacks. The panels of one section on this board are capable of accommodating 5500 multiple jacks, and the board is at present fitted for 600 subscribers.

The plug and key shelf is fitted with 17 pairs of plugs and cords for each operator, thus allowing about 20 per cent of the subscribers on each position to be in connection simultaneously. In front of each pair of plugs is fitted a combined ringing and speaking key of an ingenious and simple pattern. Fig. 2 illustrates this key, the action of which is made clear in the diagram of the cord circuit connections.

Fig. 3 shows the connections of the subscribers' instrument and exchange apparatus. When the telephone is on the switch hook, the lines are bridged by a 1000-ohm magneto bell and a 2-microfarad condenser, so that while no current can flow from central battery *C* around the lines, the alternating ringing current from the exchange,

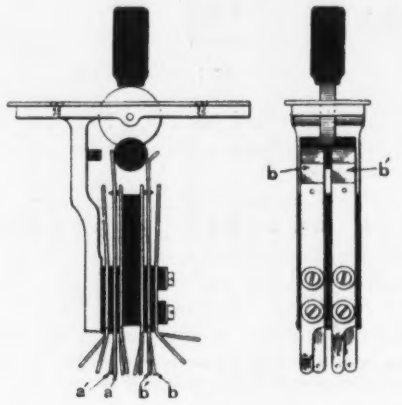


FIG. 2.—COMBINED SPEAKING AND RINGING KEYS.

which has a normal frequency of 20 periods per second, finds a path and rings the bell. On the subscriber removing his telephone from the switchhook, the transmitter, in series with an impedance coil *R*, is put across the lines, and the receiver with condenser in series shunted across *R*, which has a resistance of 25 ohms. Current now flows from the central battery *C*, through the 100-ohm relay *L*, over the *A* line, through transmitter and coil *R*, over the *B* line, and through the 100-ohm resistance coil *r* back to the battery. The relay *L* is energized and lights the calling lamp *M*, in the common connection of which is inserted the low-resistance pilot relay *PR*, which lights pilot lamp *PL*. The operating of the cut-off relay *O* will be considered in connection with the cord circuit.

A peculiarity of this board is the use of two-point jacks throughout the multiple and for the locals, the engaged test being obtained on the *B* line. This constitutes a considerable saving in expense; for example, a saving of about 40 miles of test wire is effected in a 5000 line exchange, besides the difference in the cost of the simpler multiple and local jacks, of which about 130,000 would be required.

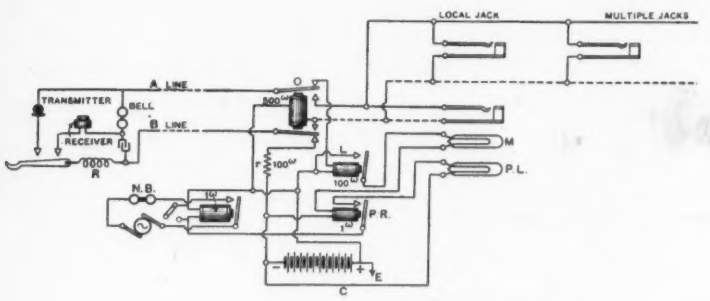


FIG. 3.—LINE CONNECTIONS.

Fig. 4 shows the two-way plugs and the two-point jacks. The combined *B* line and test wire is connected to the bush *B* of the latter (which is made of German silver), and although the barrel *A* of the plug fits quite easily into this bush, the contact between them is reliable, as the weight on the cord keeps the barrel of the plug firmly pressed against the bush.

Fig. 5 is the cord circuit. The action can be most readily followed by examining this diagram in connection with Fig. 3. The subscriber having made a call, the operator inserts an answering plug into his local jack; a circuit is now formed through the cut-off relay *O*

(Fig. 3), which is tapped on the bush of the jacks, and thence by the barrel of the plug through the 100-ohm relay *D'*, to battery 1 and earth. Both relays are, therefore, actuated, the relay *O* cutting off the calling relay, lamp, etc., and relay *D'* connecting up the first clearing lamp, which, however, does not light, as its circuit is broken by the 100-ohm relay *D*. This is actuated by the current from the battery flowing round the lines through the subscriber's transmitter and retardation coil. The operator now places the combined speaking

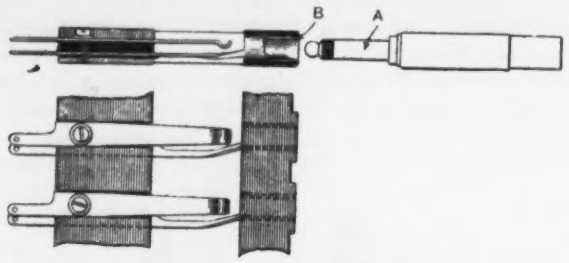


FIG. 4.—PLUG AND JACKS.

and ringing key in the speaking position, when line springs *b, b'* (see also Fig. 2) will be connected to her telephone.

Having ascertained the number of the subscriber required, who we will assume is a "local" subscriber (*i. e.*, one in the same exchange) she touches the tip of the calling plug on the bush of the jack connected to the required line, which, if engaged, it will be remembered, would be connected to battery and earth. Presuming the line to be engaged, current will be drawn from this battery through the outer tongue and contact of relay, *E'*, to the special engaged test relay *C* of 5000 ohms resistance, and thence to earth. This relay, one of which is provided per position, actuates readily with 1 milliampere, and, when closed, draws current through the primary circuit of the operator's induction coil, by this means inducing a click in her receiver. In such a case the calling plug is put into a busy-back jack, which transmits an interrupted humming sound to the subscriber, as an indication that the line is engaged.

If, however, the line is free, the plug is inserted into the multiple jack, the cut-off relay is thereby actuated, also the 100-ohm relay *E'*, which not only connects up the second clearing lamp, but also cuts off the engaged test relay *C*, and joins the *A* line through from the tip of the one plug to the other, through a 2-microfarad condenser. The operator now puts her combination key in the ringing position, the springs *a, a* being pressed against the inner contacts, thus disconnecting the calling plug from the remaining part of the cord circuit, and connecting the tip direct to the ringing generator *G*, resistance lamp and earth and its bush to battery and earth. The ringing current now passes from the generator over the *A* line, through the bell, and back over the *B* line to battery and earth. The battery is left on the line so as to maintain the cut-off relay actuated.

The wanted subscriber having answered the bell, the operator puts her combination key to the through position, and the two subscribers are enabled to converse with each other, the originating subscriber drawing current for speaking from battery 1 through the two 100-ohm relays *D, D'*, and the called subscriber using battery 2 and relays *E, E'*. The two sets of relays are separated by condensers from each other.

When the originating subscriber hangs up his telephone, relay *D* is released, and the first clearing lamp lights; similarly, the other subscriber releases relay *E*, and the second clearing lamp lights. The operator does not withdraw the plug until both lamps light.

The remaining apparatus on the cord circuit consists of a pilot relay and lamp, *PL;* a night bell relay which closes a circuit through a magneto night bell, *NB*, and the ringing generator; a ringing key, *CR*, for ringing on the call wires to other exchanges at night time; and an impedance coil of 140 ohms resistance, which serves the double purpose of reducing the current through the operators' transmitters, and keeping down the cross talk between them.

Fig. 6 shows the connections of a junction line, incoming at Battersea and operated by means of a call wire. The junction operators take 26 lines, each of which terminates on a plug. The outgoing end of the junction is also shown. The originating operator requiring a Battersea number depresses a call key, which connects her instrument to the call wire to Battersea, as shown. The operator on the incoming junction board at Battersea is continuously listening on the call wire in the day time. Her instrument, *T*, is shown connected to the call wire. At night time, when the traffic is not large enough to warrant continuous listening, the call wire is switched on to a relay and lamp, so that the originating operator can ring on the call wire and attract Battersea's attention. The Battersea operator having been advised of the number required picks up a disengaged plug, and gives the originating operator the number of the junction she has taken. This operator plugs into the jack terminating the junction, and actuates the relay *O*, which disconnects the battery *B* from the junction lines. The Battersea operator in the meantime tests the line required with plug *P*, obtaining the engaged test through the tip of the plug, one tongue and back contact of relay *F'*, and the 5000-ohm relay *E*, in the manner described in connection with the subscriber's cord circuit.

If the line is disengaged the plug is inserted, and the act of insertion automatically rings the subscriber, this being effected by means of the ringing relay *RR;* this has two windings on it, *a* and *b*, each of 500 ohms resistance, and acts in the following manner: On the insertion of the plug *P* the 100-ohm relay *F'* is actuated, and there is a circuit from the earthed ringing generator *G* round the *a* winding of the ringing relay *RR*, through its front armature and back contact, to one of the armatures and front contact of *F'*, to the tip of the plug *P*, and thence through the subscriber's bell and condenser in series, back over the *B* line through relays *F'* and *H* to battery and earth. The subscriber's bell is therefore rung, and although the ringing current is flowing round the *a* winding of the relay *RR*, this relay is not actu-

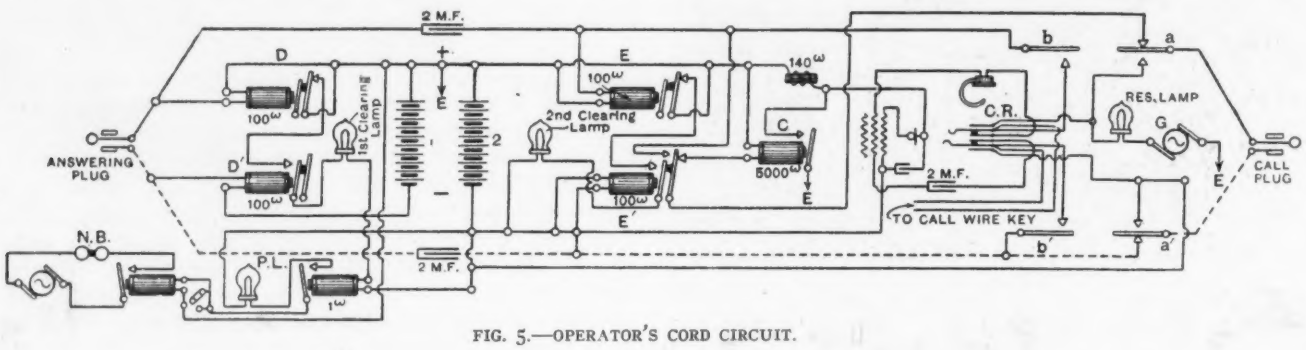


FIG. 5.—OPERATOR'S CORD CIRCUIT.

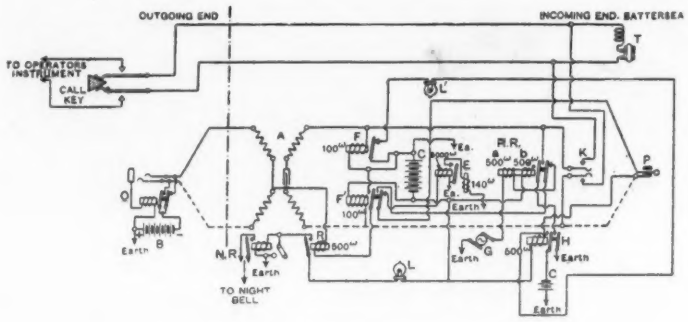


FIG. 6.—JUNCTION LINE OPERATED BY CALL WIRE.

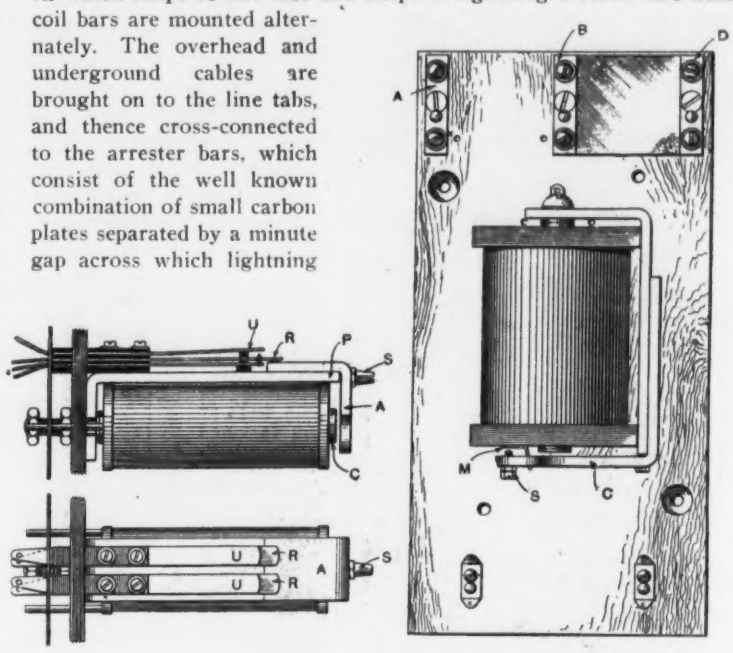
ated, as it is so adjusted that the ringing current through the subscriber's bell and condenser is not strong enough to affect it. Directly, however, the subscriber takes his telephone off the hook there is a path for the battery current round the transmitter and impedance coil and through the *a* winding of *RR*, and this is strong enough to pull up *RR*, which is retained in this position by current from battery *C*, through the *b* winding, front contact and tongue of *RR*, and thence

to earth, by front contact and tongue of 500-ohm relay *H*, which was also actuated on the insertion of the plug. The ringing current, which is interrupted at regular intervals in order to approximate to non-automatic ringing, is thus cut off, and the subscribers are through to each other.

When the Battersea subscriber hangs up his telephone, he lights the clearing lamp *L'* as he releases relay *F*. *H* being still retained, there is a circuit for lamp *L'* through back contact of *F* to earth, and through front contact of *H* to battery *C* and earth. The originating subscriber clears in any of the usual ways, and the originating operator withdraws the plug from the outgoing jack, releasing relay *O*, and thus putting the earthed battery *B* on to both lines of junction, so that current flows over both lines, through the center point of the junction side of translator *A*, through relay *R* and front contact of relay *F'* to earth, *R* being actuated and lamp *L* lighted. The Battersea operator now withdraws thee plug *P*, thus releasing relays *H*, *F* and *F'*, and returns everything to the normal position. The function of the translator is to prevent the current from *C* flowing back over the junction lines and affecting any of the apparatus.

Fig. 7 is a view of the back of the switchboard; the clearing relays can be seen at the lower part. At the top of the board are mounted the engaged test, pilot and night-bell relays, ringing resistance lamps, and operators' induction coils and condensers. Figs. 8 and 9 shows examples of the two types of relays used. Fig. 8 shows the pattern used for the cut-off, line, clearing and junction ringing relays; the arrangement is very simple, and at the same time thoroughly satisfactory in operation. One end of the core *C* is brought round in front of the coil, and an L-shaped armature *A* is loosely supported on the pole *P* by a screw *S* which passes through the center of the armature. When the lower part of the armature is attracted towards the core, the upper part rises and is assisted in this action by the repelling force between it and the pole of the core on which it rests. It thus presses up the moving springs *R* against the upper contact springs *U*.

Relays of the type illustrated in Fig. 9 are used for the low resistance night bell and pilot relays (between 1 and 2 ohms), and for the 5000 ohm engaged test relay, which operates with a current of 1 milli-



FIGS. 8 AND 9.—DOUBLE AND SINGLE RELAY.

ampere. The principle is the same as in those previously described, but as fewer of these relays are required, they are built on larger lines and mounted on separate wooden bases. The single contact *S* is fastened to the lower end of the armature. The make contact *M* and armature *C* are wired to terminals *A* and *B*. *D* is mounted so that a fuse can be inserted between it and *B*, and a piece of mica is fastened between them, which is found ample protection from fire risks on account of the low voltage used (24 volts).

Fig. 10 shows the main distributing board and part of the relay rack. The former consists of a frame built of angle and strap iron, on which strips of line tabs and strips of lightning arrester and heat coil bars are mounted alternately. The overhead and underground cables are brought on to the line tabs, and thence cross-connected to the arrester bars, which consist of the well known combination of small carbon plates separated by a minute gap across which lightning and high-voltage currents generally, with a potential of over 300 volts, can pass to earth, and heat coils designed to break the circuit when heated by lower voltage currents of over 0.5 ampere. The testing of lines, both in and out, is also carried on from these strips, which thus act both as test jacks and arresters. This plan, however, is found to decrease considerably the speed of testing. The intermediate distributing board is a very similar framework, with strips of multiple and local tabs arranged in alternate vertical rows. The function of this board is to enable a subscriber's line, together with his set of multiple jacks, to be readily transferred from a local jack and line lamp, etc., on one particular position, to a similar jack, etc., on an-

FIG. 7.—BACK OF SWITCHBOARD.

other position, in order to equalize the work per operator. It also provides a convenient place to disconnect a line temporarily for exchange fault testing purposes.

Switchboard cables from the arrester strips are connected to the

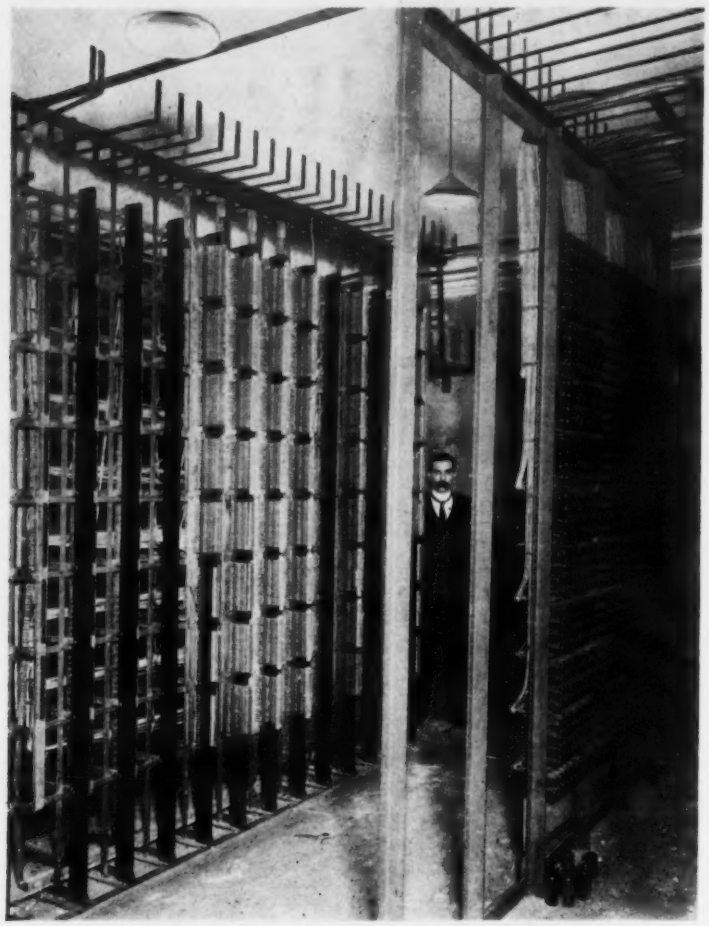


FIG. 10.—MAIN DISTRIBUTING BOARD AND RELAY RACK.

strips of multiple tabs, which again are connected to the multiple jacks on the switchboards and cross-connected to the local tabs, these communicating with the local jacks, line lamps and line and cut-off relays. The relay rack carrying the latter is the one seen in Fig. 10.

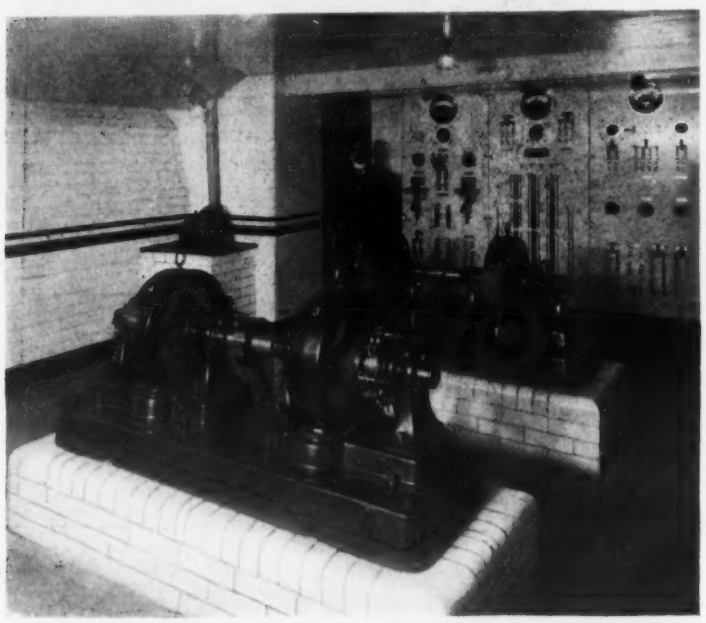


FIG. 11.—GENERATING ROOM.

Fig. 11 is the generating room. There are two Holtzer-Cabot motor dyanmos. The motors take current at 220 volts, and the output of the dynamos is 60 amperes at 30 volts. The ringing dynamotors are mounted on piers at the left-hand side of the room. One of these is driven from the 220 volt supply mains and the other from either of the two 24-volt batteries. These machines, besides supplying ringing current, carry commutators for producing the busy-back humming sound and interrupting it at the rate of about once a second in order that the note should not be confounded with induction from mains carrying alternating current. There is also a commutator for interrupting the supply of ringing current to the automatic ringing relays used on the junction lines. The power, switch and fuse board, seen at the bottom of the room, is equipped with Weston measuring instruments, including a low-reading voltmeter and wheel switch, by which the voltage of each of the 22 cells can be individually tested, also switching and regulating arrangements for the charging and ringing machines.

The individual fuses on the central panel of the board protect the operators' speaking circuits, etc. There are two sets of eleven 10-plate 180-ampere-hour chloride cells, in lead tanks which are capable of carrying a larger number of plates to allow for increase in capacity.

We are indebted to our London contemporary, *The Electrician*, for the material of this article.

Revived Rumors of Telephone and Telegraph Combination.

The old reports and rumors are being revived as to the early possibility of a consolidation of the telegraph and telephone interests of the country, i. e., the Bell telephone system, the Western Union system and the Postal Telegraph system, which would also carry with it the submarine cable network almost in its entirety. This is emphatically a large order and certainly could not be done much under $1,000,000,000, if the cables are included, or perhaps $750,000,000 without them. With respect to the reports we reprint for whatever it is worth the following from the *Boston News Bureau*, which has been quite assiduous with the *Wall Street Journal* in publishing them:

"A gentleman thoroughly familiar with the telegraph and telephone situation says that the formation of the new Western Telephone & Telegraph Company was the first move toward an amalgamation of all the telephone interests in the country working under the American Telephone & Telegraph Company patents. The recent appointment of the president of the Cumberland Telephone Company, as president of the Southwestern division of the new Western Company, and the appointment of the president of the Nebraska Company at the head of the Northwestern division of the Western Company, and the appointment of the president of the Missouri-Kansas Company at the head of the Wisconsin Company is a step of progress in the direction indicated. It is becoming more difficult yearly to finance the large telephone interests operated as separate companies, and the new charter of the Western Company is exceedingly liberal and will permit of great expansion. The bonds are so drawn that they can be called or extended by putting up of additional collateral. So there would be no difficulty in increasing the capitalization and bond issues of the Western Company by the merger of other operating Bell companies. The first to become a part of the Western Company will be the Central Union Company, followed by the Chicago, Cumberland, Nebraska, and Missouri-Kansas combinations. As soon as this can be accomplished, the foundation will have been laid for a consolidation of far greater magnitude. The closing up of the independent telephone movement in New York and Boston through the Morse transaction and the action taken at the meeting of the American Telephone Company yesterday in adding to the Bell board of management New York men of great financial strength and large holders of Western Union, will be regarded by some as the first step toward an amalgamation of the Western Union and Postal Commercial companies with the Bell interests. Mr. Mackay, of the Postal company, is a large holder of telephone stock.

"Nothing, therefore, remains but to get the three interests together and work out the basis of merger. The saving by a consolidation of telegraph and telephone interests in operations will be at least 33 per cent. At present there are three extensive lines of wire communicating facilities all over the country used only to about 75 per cent of their capacity. The amalgamation would dispense with at least two-thirds of the offices where there are three in any one city or location as one manager with assistance can handle both the telegraph and telephone, the operation of which is so nearly alike. The same is true regarding the repair and reconstruction forces. There being 25 per cent excess wire facilities no new copper wires would be required for many years."

The Telephone in Wireless Telegraphy—I.

BY EMILE GUARINI.

THE employment of the telephone as a receiver in wireless telegraphy presents the great advantages of constituting a simple receiving apparatus, easily manipulated, inexpensive and, above all, extremely sensitive. The telephone can be used as a receiver of signals—for example, those of the Morse code—transmitted by any of the forms of radiant energy, namely, sound, light, heat and electricity.

FIG. 1.—SIGNALING BY SOUND.

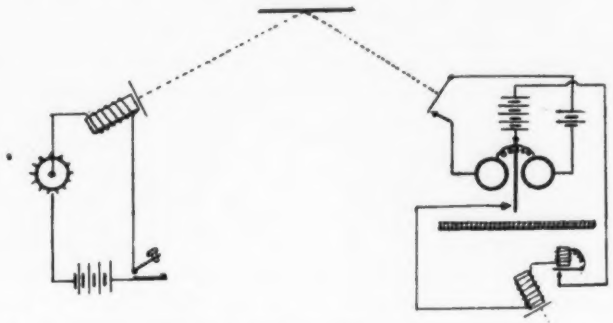


FIG. 2.—SIGNALING BY SOUND, EMPLOYING REPEATER.

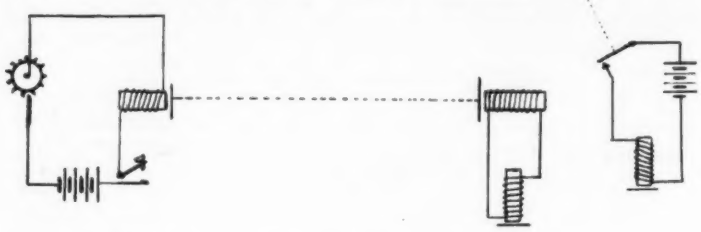


FIG. 3.—SIGNALING BY SOUND, EMPLOYING REPEATER.

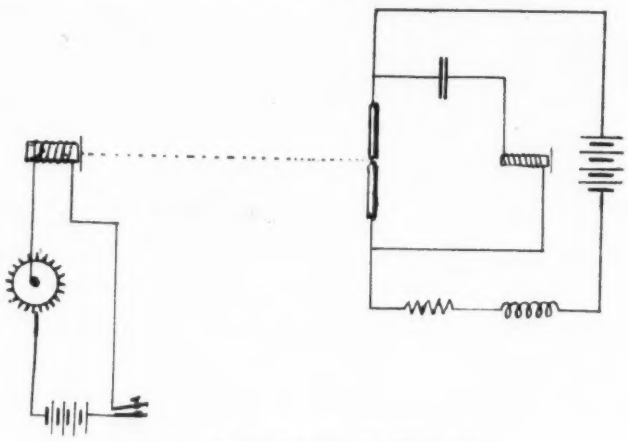


FIG. 4.—SIGNALING BY ELECTRIC ARC.

WIRELESS SIGNALING BY MECHANICAL VIBRATIONS.

A very simple method of applying this means of wireless telegraphy is to agitate the air at determined intervals by means of a vibrating plate electrically operated. The vibrations may be communicated to a sensitive membrane, which will make and break the circuit of a battery and a telephone. Referring to Fig. 1, an electrical siren of of the Trouvé type may be put in circuit with a storage battery and a Morse key. If the sound waves are reflected by a surface as shown, in the telephone will be heard short or long sounds corresponding to the dot and dash of the Morse code. With proper selective telephones of the Mercadier type, multiplex signaling will be possible. With this arrangement and employing a sensitive vibrating diaphragm at the receiver, signals may be transmitted over distances almost equal to the range of sirens, particularly at sea. That is to say, over distances of more than six miles. It is doubtful, however, if it would not be better to receive the signals with the ear, the tympanum of which is a membrane difficult to equal in sensitiveness.

With the above arrangement signals may be sent over any distance

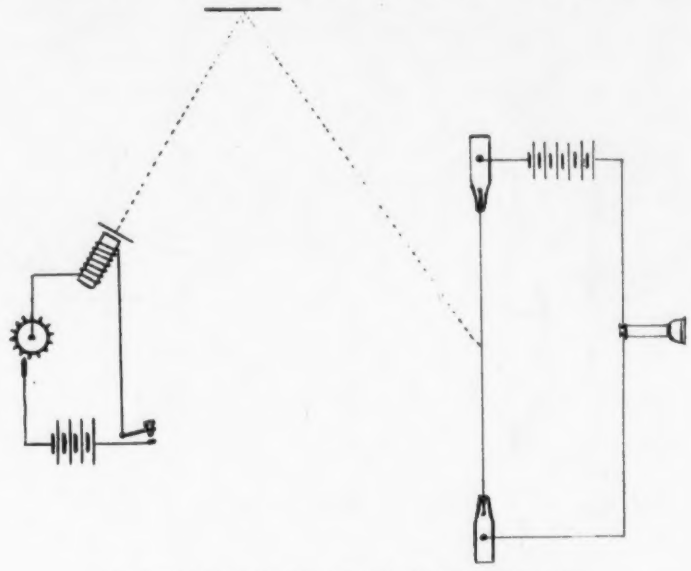


FIG. 5.—SIGNALING BY MEANS OF HEATED WIRE.

by the employment of proper repeaters. Referring to Fig. 2, the vibrating diaphragm of the receiver closes the circuit of a relay, which

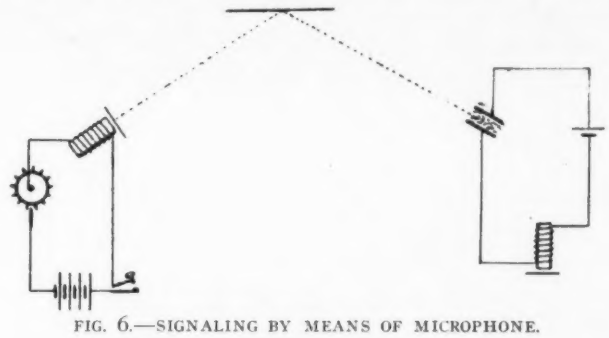


FIG. 6.—SIGNALING BY MEANS OF MICROPHONE.

actuates a siren. A reflecting surface concentrates the sound waves of the siren of the repeater on another repeater or on the extreme signaling station. By a similar arrangement the diaphragm of a distant magnetic telephone may be vibrated, which in turn will actuate at a further distance a telephonic receiver (Fig. 3).

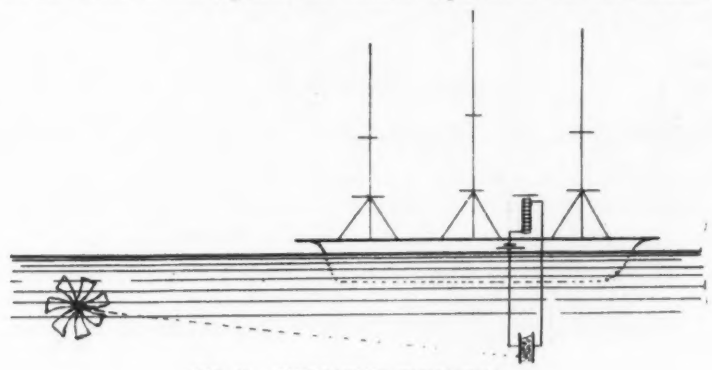


FIG. 7.—SUBMARINE SIGNALING.

Instead of producing variations in the magnetic field of the telephone, similar variations may be produced in a voltaic arc. Fig. 4 corresponds to the Duddel-Simon arrangement, by means of which signals may be transmitted over relatively great distances and received in a telephone. Signals may be also received in a telephone in circuit with a platinum wire kept at incandescence by current from a storage battery. The sound waves will produce changes of resistance in the incandescent wire, which will give rise to signals in the

telephone on account of the variations of current caused by the change of resistance (Fig. 5). This arrangement is no other than the thermotelephone of Preece, in which the relatively feeble human voice is magnified to resemble the sound from an electric siren. The arrangement, however, which in practice gives the best result, is indicated diagrammatically in Fig. 6. In this case the sound waves act on a microphone in circuit with a battery and a telephone. This

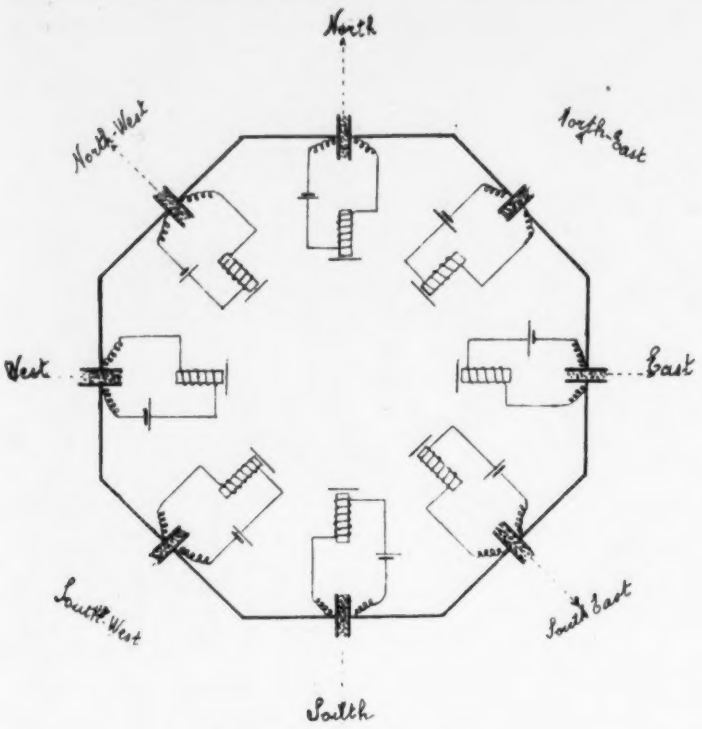


FIG. 8.—ROSSO D'ASAR METHOD.

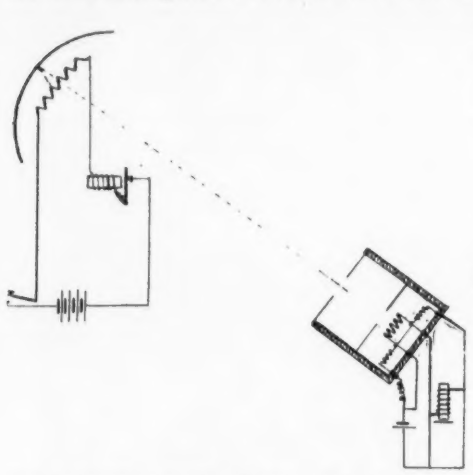


FIG. 9.—SIGNALING BY HEAT VIBRATIONS.

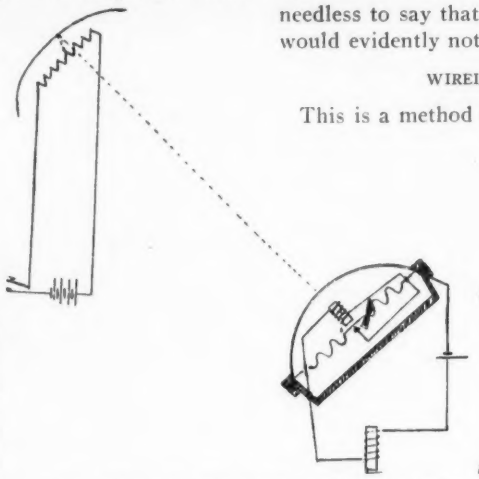


FIG. 10—SIGNALING BY HEAT VIBRATIONS.

system can be of great service on railroads and at sea. Thus, for example, a microphone installed under a vessel will be affected by the beat of the screw of an approaching boat up to four miles, according to experiments that have been made (Fig. 7).

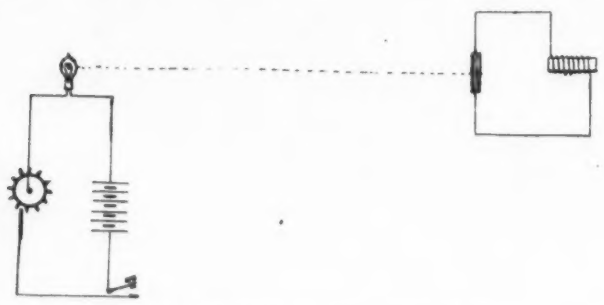


FIG. 11.—SIGNALING BY LUMINOUS RAYS.

M. Rosso d'Asar has devised a similar arrangement, which has been tested in the Italian navy. Special microphones are disposed in the sides of a polygon (Fig. 8). Depending upon which telephone gives a signal, the direction may be determined from which a vessel is approaching.

WIRELESS SIGNALING BY HEAT VIBRATIONS IN THE ETHER.

This method of wireless telegraphy will be disposed of by a brief notice, as it does not seem to be susceptible of practical application.

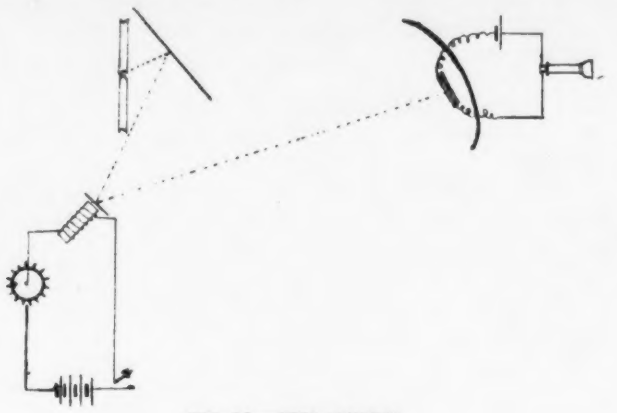


FIG. 12.—BELL SYSTEM.

Referring to Fig. 9, a circuit includes a signaling key, a storage battery and a resistance, and a source of radiation located in the focus of a parabolic reflector. The receiver is merely a Langley bolometer, in connection with which a telephone takes the place of the galvanometer. A Melloni thermo-multiplier or a Nobile thermopile could also serve as a receiver. Another receiver for calorific signals is that indicated in Fig. 10. The transmitter is the same as that of the preceding method, while the receiver is based on a principle which has been applied in fire-alarm apparatus. It consists of a hemisphere of thin brass closed by a thin metallic diaphragm. When the hemisphere is heated the air contained dilates and presses out the diaphragm, which closes the circuit of a battery and a telephone. It is scarcely needless to say that the speed of transmission with this arrangement would evidently not be very great.

WIRELESS SIGNALING BY LUMINOUS RAYS.

This is a method of wireless signaling which has received, notably for military purposes, a number of practical applications for transmissions as high as 100 miles. A very simple means of applying this system is to employ at the transmitting end a powerful luminous source, a reflector and a manipulating screen; and at the receiving end a selenium cell in circuit with a battery and a telephone. A method of applying this system for signaling over short distances is

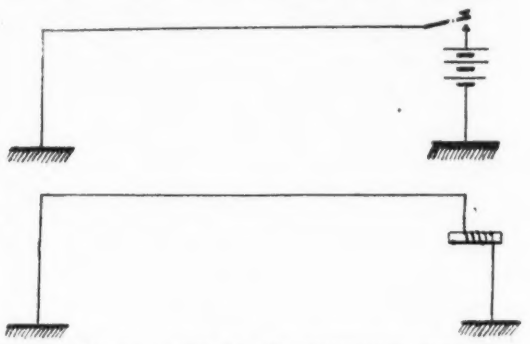


FIG. 14.—LINSAY AND BOURBOUZE METHOD.

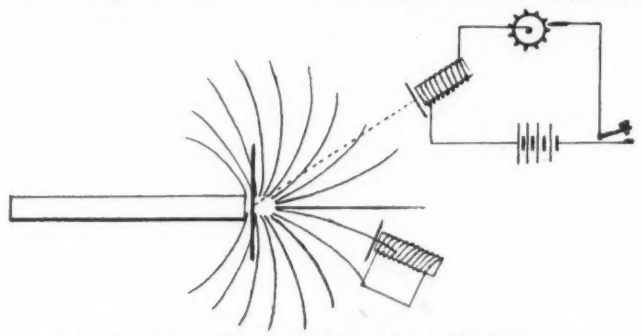


FIG. 13.—SIGNALING BY ELECTROMAGNETIC INDUCTION.

to employ (Fig. 11) at the transmitting end an electric lamp, a source of energy, a signaling key and at the receiving end a receiving cell with or without a battery in circuit with a telephone.

Another method which is still more practical is that based upon the photophone of Bell. A pencil of luminous rays emitted by an arc lamp is reflected by a reflecting surface on the vibrating diaphragm of an electric siren, in a direction to strike a selenium cell placed in the focus of a parabolic mirror and in circuit with a battery and a telephone. When the siren operates, the pencil of luminous rays is deviated and the variation in the light striking the selenium cell produces variations of current which give rise to predetermined signals in the telephone. (Fig. 12.)

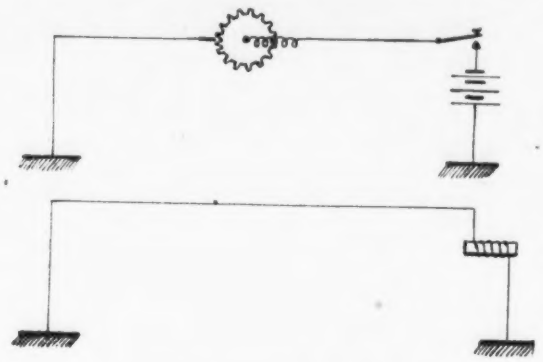


FIG. 15.—PREECE METHOD.

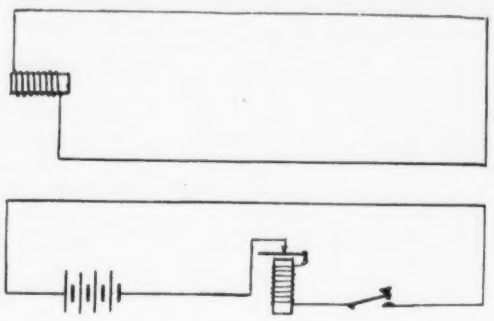


FIG. 16.—PREECE METHOD.

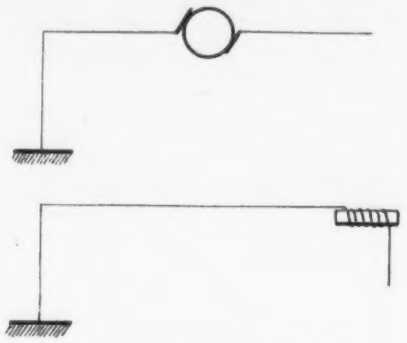


FIG. 17.—OPEN CIRCUIT METHOD.

WIRELESS SIGNALING BY ELECTROMAGNETIC VIBRATIONS IN THE ETHER.

We now come to a means of wireless signaling which, as it is well known, has given very remarkable and interesting results in practice. If by means of an electric siren (Fig. 13) operated at longer and shorter intervals by a key, variations are produced in a magnetic field—for example, by causing a metallic diaphragm to vibrate in the field—and if a telephone is placed in the field thus rendered variable, currents will be induced in the winding of the telephone and the diaphragm will reproduce the signals of the siren. It is doubtful if with this disposition signals can be sent over very great distances; by the following method, however, better results may be obtained with a simpler arrangement.

In Fig. 14 are shown two parallel telegraphic lines, one including a battery and a signaling key, and the other a telephone. By manipulating the key currents pass through the ground and over the other line, where, by acting on the telephone, the signal sent will be reproduced. This arrangement, employing a galvanometer, was experimented with by Linsay and Bourbouze in 1871-1876.

If in the transmitting circuit an interrupter (Fig. 15) is introduced, for example, a toothed wheel, signaling by induction is rendered possible. This arrangement is that which Sir William H. Preece employed about ten years ago to communicate between Penarth and Flatholm over a distance of 3.1 miles. It is not even necesesary to employ a telephone diaphragm, as the signals may be received, though more faintly, by means of the "magnetic tick" due to the rapid magnetization and demagnetization of the telephone magnet. (Fig. 16.) Moreover, open circuits may be employed at both the receiver and transmitter by using capacities—for example, the earth—at one of the terminals (Fig. 17), the source of energy consisting of an alternating-current generator. In that case the currents of charge and discharge incident to the operation of the signaling key, produce corresponding currents in the receiving line, including a telephone in circuit.

Edison in his system of signaling without wires for application aboard ship, patented in 1899, also employed open circuits. Referring to Fig. 18, at each station there was a Ruhmkorff coil, in the primary of which was included a variable source of electricity and a signaling key; the secondary at one end was grounded and the other connected with a vertical antennæ having capacity at its upper end, a telephone being connected with the other end of the secondary to serve as a receiver.

Several of the above methods have been applied for signaling to and from moving trains. Thus Phelps stretched between rails an insulated line communicating with the earth by its extremities, and

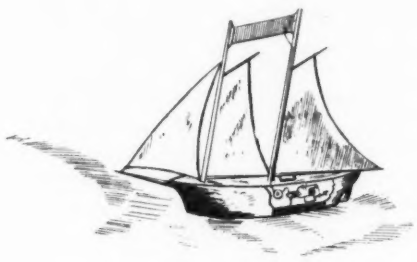


FIG. 18.—EDISON METHOD.

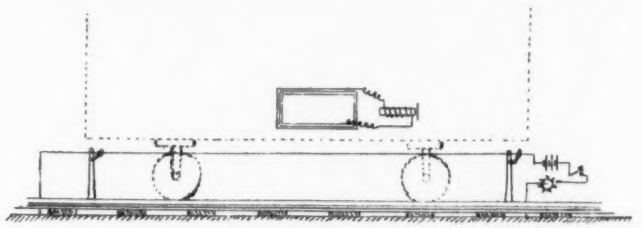


FIG. 19.—PHELPS SYSTEM.

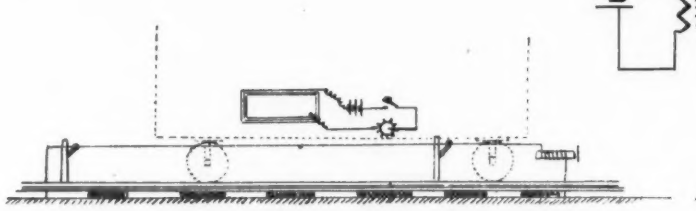


FIG. 20.—PHELPS SYSTEM.

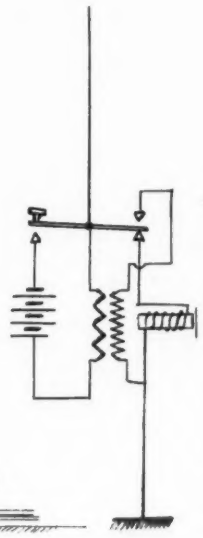


FIG. 21.

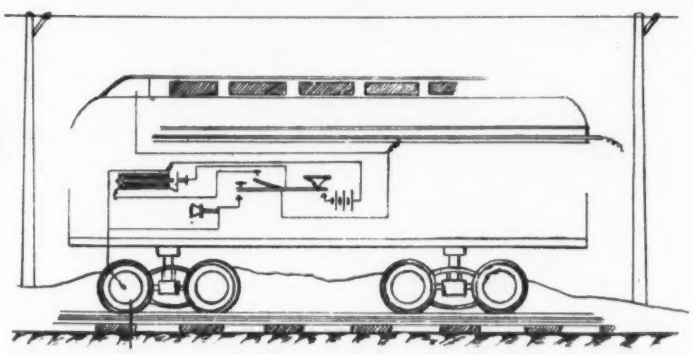


FIG. 22.—EDISON SYSTEM.

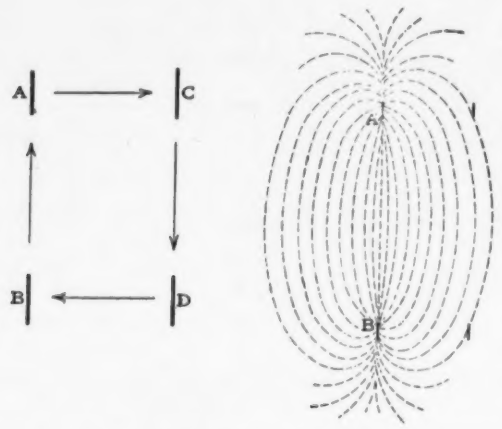
containing a battery and interrupter and a Morse key (Fig. 19). On the train there was a rectangular coil, with a telephone in circuit. To transmit from the train an inverse arrangement was employed, the transmitter taking the place of the receiver (Fig. 20). Edison modified his method above described and in conjunction with Gillilland devised a means for signaling to and from trains in motion (Fig. 22), the roof of the car, when of metal, corresponding to the capacity of the antennæ, and the circuit being grounded through the wheels and the rail. A line stretched parallel to the track served to transmit signals to and from the train.

Wireless Telephony.

BY A. FREDERICK COLLINS.

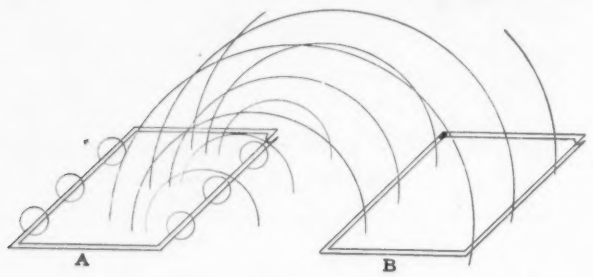
THE advance in wireless telegraphy has been so great and the achievements so brilliant that the art of telephoning without wires has attracted little serious attention. Occasional reports, however, show that work along this line has not been altogether neglected, although very little has been published in the technical journals.

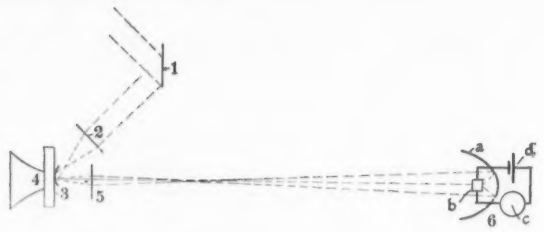
There are at the present time five distinct methods known for transmitting articulate speech between two given points without connecting wires, besides possibly some combinations of these. The



FIGS. 1 AND 2.—DIAGRAM OF EARTH RETURN CIRCUIT.

first and oldest method is that by pure conduction through the earth or water. In this system the base lines extend parallel with each other, the length of which is usually much greater than the distance over which speech is to be transmitted; the terminals of the base lines are earthed. When a current is passed through one of them, either direct or alternating, the return circuit is joined through the earth between *A* and *B*, Fig. 1, and in virtue of the infinite cross-section of the earth, it is found by tracing and plotting, that the current-flow or stream lines assume the curves shown in Fig 2, forming





FIGS. 3 AND 4.—ELECTROMAGNETIC WIRELESS TELEPHONY.

a hemispheroid. By this arrangement speech has been sent across a space of eight miles, using base lines twenty-five miles in length. Now this is, in a measure, wireless telephony, but its limiting features prevent its employment from the standpoint of practice, though it could, no doubt be used to advantage in special cases.

It is almost of weekly occurrence that a report is published in the daily papers of some new invention or discovery for telephony without wires, and with a fanfare of trumpets it is announced that the wire system will be put out of the business. In nearly every instance the case may be traced to a re-discovery of the dual base lines, wherein the length of wires exceeds the wireless distance to be traversed.

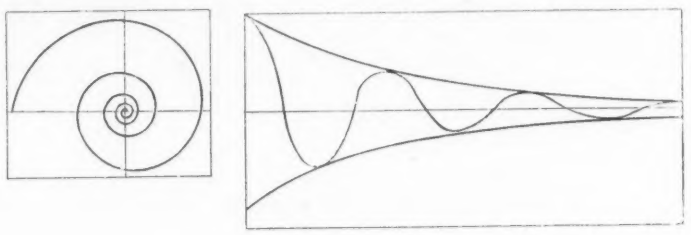
The second method, which, could it be perfected, would be ideal for wireless telephony, is the electromagnetic mode of propagation. Two closed coils of wire *A* and *B*, Fig. 3, are placed with their planes parallel to each other or with their planes horizontal, as shown. On closing the circuit in the coil *A*, it will be instantly surrounded by electricity in rotation or magnetic lines, sometimes called Faraday's tube. These curved magnetic lines spread out in circles, some of which are large enough to enclose the coil *B*. At the instant the lines from the first coil thread through the second coil, an e. m. f. proportional to the rate at which they link with the coil *B* causes a momentary current to pass through the receiver. Here no earth connection is necessary, but as in the conductivity system the limitations are reached before the practical value begins. For this reason it has found little favor with experimenters in wireless telephony.

An ingenious system for the wireless transmission of speech is by employing a beam of light from either the electric arc or the sun. The instrument is called a *radiophone* when the rays from the sun form the conducting path, or a *speaking arc* when the rays are emitted by an arc light. In the radiophone a beam of sunlight is allowed to fall on the mirror 1, Fig. 4, and is reflected through the lens 2; the conveying pencil of light falls on a mirror attached to the back of the transmitter diaphram 3, which is clamped to the mouthpiece 4. The light after reflection from the mirror now passes through a second lens 5, and is projected through space to the receiver. This latter consists of a parabolic reflector, *a*, a selenium cell, *b*, and a telephone receiver, *c*. The light is converged to a point in the focus of the reflector and impinges upon a selenium cell, *b*, in circuit with a voltaic battery, *d*, and the telephone receiver, *c*. The selenium cell is constructed by forming a grid of conducting wires between fused selenium. In the radiophone and speaking arc the transmission depends, first, on an uninterrupted line of view between the receiver and transmitter, and, second, upon the sensitiveness of the apparatus. The actual distance to which radiophonic transmission may be effected is several hundred feet.

The fourth system encroaches upon the domain of Hertzian wave telegraphy. It is well known that an alternating current of comparatively low frequency will emit electric waves; the higher the frequency and potential, the greater the dissipation of energy in the form of electric waves. To produce waves of any considerable penetrating power the frequency must be increased to a million or more per second; in other words, a disruptive discharge breaking down an air-gap, thus forming an open circuit of low resistance, has been found necessary for long-distance wireless telegraphic work. Under these conditions the current is not only alternating, but decreases periodically, reaching zero in a very small fraction of a second. The decrement of the wave may be determined by the first amplitude and the ratio of any two successive amplitudes.

The period of oscillation in polar co-ordinates is represented in Fig. 5, and also in rectangular co-ordinates in Fig. 5A.

Thus is will be seen at once that the oscillating current is incompatible with the long, smooth curves to which we are accustomed in the undulatory motion of electric currents produced by the vibra-



FIGS. 5 AND 5A.—PERIOD OF OSCILLATION.

tions of a transmitter diaphram. If the oscillator system is closed through the spark gap by an inductance coil, and the current employed is alternating, as distinguished from oscillating, then speech may be reproduced through space by means of a suitable receiver. Again, if the oscillator system remains open through the gap and the current is caused to surge to and fro in each arm of the oscillator at every reversal in the secondary of the coil, calculations may likewise be obtained by means of a telephone, although it is exceedingly difficult to determine if the results are due to rotational currents set up around the system or electric waves emanating from it. This

system offers some promise, though the distance covered in the course of my experiments has been far less than those enumerated.

The fifth system is one on which I have been engaged for the past three years, and differs from the last in that the discharge takes place in what might be termed the earth-bound ether. When a current of sufficient potential and frequency is permitted to discharge into the earth and there allowed to restore the equilibrium, the bound ether radiates waves very much the same as the Hertzian oscillator in the air; and if a suitable receiver is provided, these waves will be picked up, transformed and reproduced in articulate speech. The same apparatus may accomplish the results in free air, but to no effective distance, thus following, coincidently, the analogue of sound transmitted in media of different densities, as when a bell

FIG. 6.—FIELD EXPERIMENTS.

struck under water sends out sound waves many times as far, as when struck in free air.

By this system I was able to reproduce speech, in 1900, a distance of 200 feet; in 1901, about a mile, and, in 1902, speech could be reproduced faintly to a distance of three miles. These trials have been made in the open country. What the performance of the instruments would be in a city I cannot say, but intend to determine in a short time.

That this or any wireless system will ever take the place of the efficient wire service now in use is hardly probable, but it will, no doubt, find its special sphere just as the wireless telegraph has. As an illustration, nearly all the vessels wrecked are the result of collisions, due primarily to an unseen or misunderstood signal; if vessels were equipped with wireless telephones, the pilots would be placed on the same basis as the modern business man, instead of relying on signals that were used by prehistoric men in the stone age. Fog and darkness would be robbed of half their terrors and hundreds of lives and millions of property would be saved every year.

Independent Telephony in Michigan.

At the recent annual meeting of the Michigan Independent Telephone Association, which was held in Detroit, extensive gains throughout the State during the past year were reported by the delegates present. The Association's strength at the present time is greater in the smaller cities, the companies in many instances having more instruments than the Bell Company. In the larger places the rapid strides of the Independent people have caused the old company much distress. The number of independent telephones in some of these towns was given as follows: Northville, 136; Plymouth, 130; Allegan, 251; Burr Oak, 260; Blissfield, 152; Hastings, 362; Nashville, 141; Middleville, 132; Vermontville, 198; Reed City, 131; Cadillac, 230; Frankfort, 80; South Haven, 245; Fenton, 125; Corunna, 58; St. Johns, 230; St. Louis, 145; Bad Axe, 50. In these towns it was reported the Bell company had but one instrument.

In the cities of Hart, Saginaw, Muskegon, Alma, Kalkaska and Adrian, according to a table presented, the independent telephones in service far outnumber those of the Bell company.

The Acker Electrolytic Alkali Process.

BY CLINTON PAUL TOWNSEND.

IN ELECTRICAL WORLD AND ENGINEER for June 1, 1901, the present writer commented briefly upon the Acker cell, as disclosed in recent patent specifications, and referred to the interesting parallelism between the Acker process, employing a fused electrolyte and a circulating molten cathode of lead, and the mercury cathode cells for the production of caustic solutions from brine. In respect to temperature the Acker cell operates at a higher level, and this is the sole difference between the methods; molten lead is substituted for mercury, fused salt for an aqueous solution, and steam for water as the oxidant; as product, anhydrous caustic is obtained in place of a somewhat dilute solution. By reason of this parallelism, a comparison of the processes is of the greatest interest as affording a general insight into what may be called the specific characteristics of molten electrolytes and aqueous solutions. As will be seen, the efficiencies of the two methods, whether calculated upon the expenditure of current or of energy, are nearly equal; in the matter of concentration of energy and of plant, the fused bath process possesses an enormous advantage. From a theoretical viewpoint, therefore, the industrial advantage would appear to lie with the former method, and interest centers upon the installation itself, the method and means for handling that *bete noir* of the electro-chemist, a fused electrolyte.

It has been the privilege of the writer, through the courtesy of Mr.

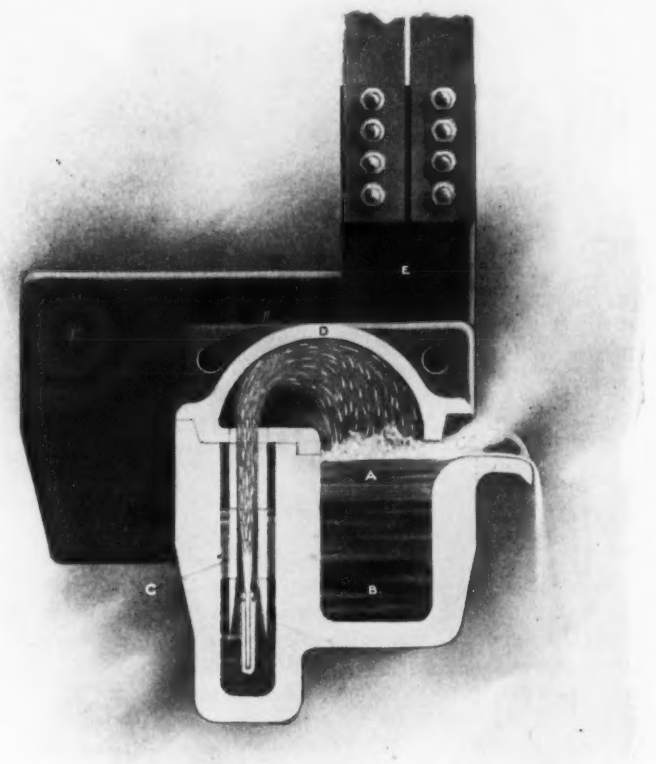


FIG. 1.—ELECTROLYTIC ALKALI PROCESS.

Acker, to follow his process from its infancy in the experimental plant, in Jersey City, to its final form at Niagara Falls. It is not necessary at this time to relate the improvements which have from time to time been made; but a statement of the work of prior investigators will be of interest as more clearly indicating the character of the difficulties which had to be overcome, and as defining the limits of Mr. Acker's contribution to the progress of the art.

The earliest investigator of the lead-sodium alloys on more than a laboratory scale seems to have been Dr. A. J. Rogers, who published the results of his work in the *Proceedings* of the Wisconsin Natural History Society, the *Journal* of the Franklin Institute, the *Chemical News*, and elsewhere, about 1889. Dr. Rogers' study of these alloys was based upon materials prepared by adding sodium to lead in atomic proportions and multiples, and melting under paraffin. The

characters of these alloys are accurately given, and especially he notes the rapid decomposition of water by alloys containing an excess of 20 per cent of sodium.

Dr. Rogers on one occasion prepared a considerable quantity of an alloy approximating 17 per cent. of sodium, by electrolytically decomposing fused sodium chlorid in a crucible containing 30 lbs. of the salt and a cathode of lead, a dynamo being employed, and a current of 72 amperes passed for two hours. Owing to imperfect fusion of the salt, the e. m. f. required was exceedingly high, 21 volts, but the current efficiency seems to have been fairly good, or between 75 and 80 per cent. This investigator had no thought of the possibility of the industrial production of caustic from his alloys; their chief interest to him lay in the possibility that by their use, the De Ville process, at that time the only commercial method for the reduction of aluminum, might be cheapened, but it is nevertheless true that he did make caustic soda from lead sodium alloy. Dr. Rogers was also entitled to the credit for employing a basic lining in his electrolyzing apparatus. He tried the various basic linings, including hydrated alumina well fired, some "shrunk" magnesia lining such as is used in basic steel furnaces, etc. Magnesia linings were later suggested by two workers in this field in a different form.

Disregarding a strict chronology, reference may here be made to Dr. Borchers, who has proposed to deposit sodium from its fused salts upon a flowing stream of lead, producing alloys for various industrial purposes; a current density of 3.2 amperes per square inch of cathode was deemed most suitable, the e. m. f. required, being 6 to 8 volts. A group of English inventors, Hetherington, Hurter and Muspratt, likewise suggested the production of such alloys by the electrolysis of fused caustic soda superposed upon a cathode of molten lead.

The problem was next approached by Mr. C. T. J. Vautin, and this time with the view of obtaining caustic solutions and chlorine. Sodium chloride in an externally-heated vessel, was electrolyzed with carbon anodes, and the light metal collected in a cathode of molten lead. This cathode was prolonged into a second vessel where a small surface was exposed to the action of steam from above and through the supernatent caustic, the assumption being that the alkali metal would diffuse at once throughout the body of the lead and always toward the point of removal. This assumption is of course entirely incorrect; the lead cathode crusts over almost at once with a light alloy and secondary reactions begin—the recombination of the liberated ions, and possibly the formation of sub-chlorides—with the results of loss of sodium and rise of the e. m. f. and temperature. Furthermore, the introduction of steam *above* the caustic for the purpose of oxidizing the sodium in the alloy *below* it would require that the caustic be not anhydrous, as otherwise the sodium would not be extracted. This would mean that the temperature at this point should be far below that of the bath, in fact, considerably below red heat.

Impracticable as was this plan, one of Vautin's patents contains one interesting suggestion; this was, the maintenance of the heat of the bath by the passage of the current itself which Rogers had not mentioned. It is likely, however, that the state of the art long before Vautin's experiments would have been sufficient to have led any serious investigators to employ the current for melting as well as decomposing the salt. This one point, and the basic lining due to Rogers, and also two others which are due to Acker, are the fundamental necessities of the method.

The Vautin process received a trial on a small industrial scale at Keighley, Lancashire, Eng., in 1893-1894, but was quickly abandoned. Meantime, Leon Paul Hulin, at Modane, Savoy, attacked and solved the problem, and this in a most ingenious manner. Recognizing the cause of the difficulty as the non-diffusion of the sodium through the lead, Hulin electro-deposits with the sodium that equivalent of lead which will constitute with it an alloy of the proportions desired, overcoming the lack of diffusion by avoiding all necessity for diffusion. Mixed chlorides of sodium and lead are electrolyzed with anodes of both carbon and lead, the latter connected in circuit through a rheostat to govern the proportion of the total current passing through it, and hence the proportion of lead dissolved and deposited.

In practice, for this process has until recently been in commercial operation at Cavet-Clavaux, Savoy, about 12 per cent of the total current was shunted through the metal anode. The voltage required is 7, affording, under the conditions, a current density of 700 amps. per square foot of cathode surface. The current efficiency is stated to be 69.3 per cent, while the energy efficiency falls to 41.5 per cent. The alloys obtained are leached with water, and by repeated washings the concentration of the solution may be brought to 50 per cent caustic (*sp. g.* 1.54). The lead is collected as sponge, for which the manufacture of storage battery plates affords some market.

If, as stated above, Hulin has solved the problem, Acker has factored it, resolving the double difficulty by a single bold expedient. This was the conception that a jet of steam might be introduced into the molten alloy to oxidize its sodium and at the same time to give to the lead such rapid circulation past the anodes that mechanical mixing might supplement the slow process of diffusion.

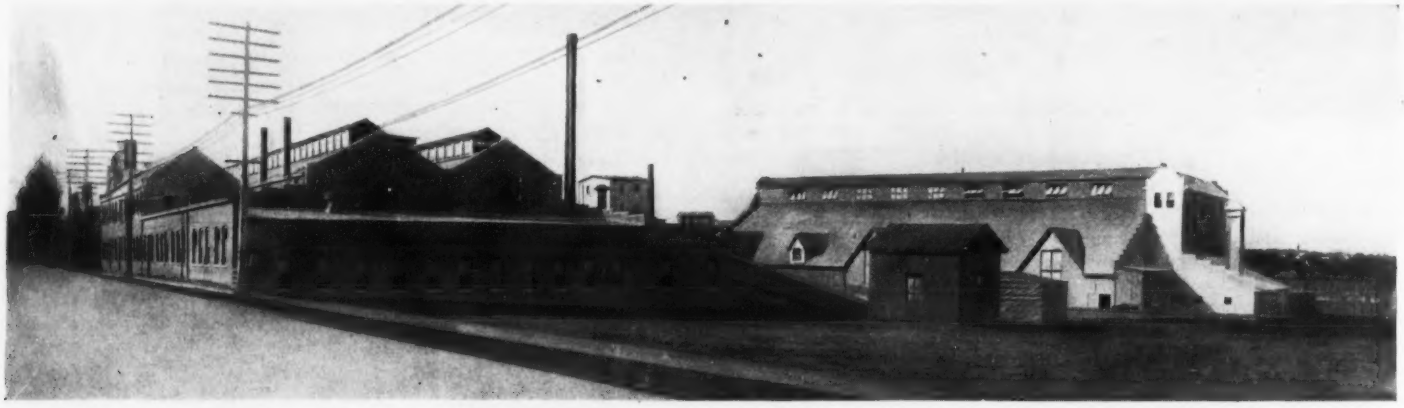


FIG. 2.—GENERAL VIEW OF THE ACKER WORKS.

The accompanying illustrations require but a word of description. The fusion pots or furnaces are of iron, cast in two parts only; a body portion *L*, for containing the electrolyte, provided with a horizontal partial partition *M*, dividing the vessel into upper and lower chambers, which communicate at one end with each other and at the other with a well *I*, wherein the steam is injected; and the cover *D*, for the well, serving the purpose of deflecting the mingled mass of molten lead, caustic and hydrogen, thrown upward by a steam jet, into a chamber *A*, where the constituents quickly separate, hydrogen burning freely at the orifice, anhydrous caustic overflowing to the individual collecting vessels, and the lead returning by conduits *B*, to pass again beneath the anodes in the upper chamber *H*. The steam pipe *J*, a thick-walled steel tube, discharges, as shown, into the casing *C*, forming a true injector, and constituting a most direct and positive means for circulating the cathode.

The anodes *G*, of which four are employed in each furnace, are graphitized carbon blocks, having a working face approximately 7½ by 14 inches, and carry 2000 amps. each, or about 19 amps. per square inch. These great carbons, prepared by the International Acheson Graphite Company, are entirely unaffected by the bath; that is to say, they undergo no corrosion or chemical action properly so called, and deteriorate only from mechanical causes, the weak point being the surface of connection with the copper rods *K*. In point of fact, the problem of a resistant anode for a fused chloride is considerably less serious than is the case with aqueous solutions, for in the molten bath there are no oxidants, nor possibility of their formation; consequently

ordinary dense carbons or carbon agglomerated with a proportion of graphite show equal resisting power with the graphitized blocks. The advantage of the latter lies in the superior facility with which they may be tooled, and their higher conductivity permits the use of a smaller cross-section. A sleeve of basic cement protects the conductors above their point of union with the anodes.

The furnaces are lined with magnesite bricks *F*, such as are used in basic steel furnaces. They are set without cement and inclined backward for stability; the electrolyte penetrates their interstices and in solidifying, combines them into a rigid wall, which seems to be entirely unaffected by the electrolyte or such of the products as come into contact with it.

Of these furnaces, 45 are now in operation with 11 more provided for. The current of 3250 e. h. p. is delivered from the Niagara Falls Hydraulic Power & Manufacturing Company at 8000 amps. and 300 volts, being transmitted directly to the factory from the power house, a distance of 1500 feet, by great aluminum cables. The Acker Company was therefore under no necessity of installing transformers. The works began operation in December, 1900, and have been in continuous operation since that time, with the exception of one week, during which no current was delivered owing to a fire in the cable tower of the power house.

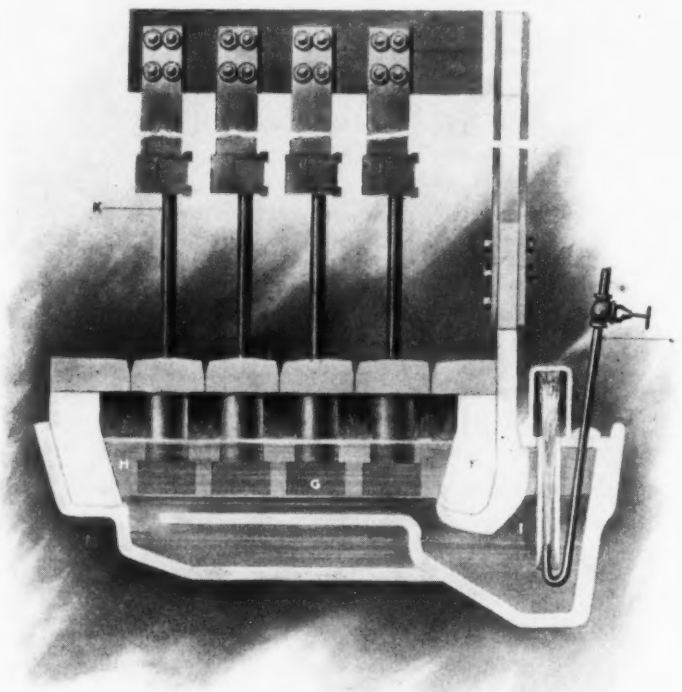


FIG. 3.—SECTION OF FUSION POTS.

The e. m. f. between terminals in the fully heated furnace is 7 volts, and, as stated, the current is 2000 amps. per anode or 8000 for each furnace, each furnace absorbing therefore about 75 e. h. p. and producing an average of 581 pounds of anhydrous caustic per day, and an equivalent of chlorine which is carried direct through conduits to the bleach house. The caustic as discharged from the furnace is anyhdrous, and this irrespective of the quantity of steam injected for circulation. For at the temperature employed, hydration is impossible, whatever excess of moisture be present. As it overflows from the furnace, the caustic is gray or often green from the presence of minute quantities of iron, and perhaps of manganates, and is cleared by a few hours' settling. Of course there is no boiling down and no further concentration required. The caustic, as it leaves the furnaces is probably the strongest that can be made.

The figures as given above afford data for an estimation of efficiencies; 8000 amps. should yield in 24 hours 633 lbs. of caustic, wherefore the actual output of 581 lbs. represents a current efficiency of 93 per cent. The theoretical voltage required for the decomposition of fused sodium chloride is 4.2, on the basis of which we may estimate the energy efficiency of the process as 55 per cent, when the furnaces are charged with cold salt, as is now the case.

Let us compare these figures with those of the Castner-Kellner mercury cathode process, as given in the *Engineering and Mining Journal*, Vol. 67, p. 497.

Efficiency.	*Current.*	*Energy.*
Castner-Kellner	91 per cent.	52.3 per cent.
Acker	93 per cent.	55. per cent.

Such a comparison, it should be pointed out, is not necessarily a test of relative commercial values, nor would it be such even if installation and depreciation factors were equal in both cases: for the energy theoretically required may, and in fact does, differ widely in the two cases, and hence efficiencies are calculated as percentages of different absolute quantities. In other words, equal energy efficiencies by no means represent equal current consumption for a given output of product. To separate .8592 gm. of sodium in one hour, one amp. is requisite, whether the electrolyte be fused or dissolved; but in the former case 4.2 watts are theoretically necessary, and in the latter 2.3 watts.

In the actual manufacture of alkali on a large scale by either the wet or dry process an estimate of the cost of production, which is based on the horse-power required only touches the fringe of the matter, and numerous other items, some of almost equal importance, must be considered therewith.

The disadvantage of the fused bath lies, not, as has been frequently stated, in the rapid depreciation of the plant nor in any difficulties surrounding the industrial handling of the electrolyte or its products, but in the fact that for its operation a somewhat greater quantity of current is required. Its over-balancing advantage is such concentration of this energy, that the output measured by the size of the decomposing plant, or the number of units employed, is relatively enormous, and for this reason it is also true that the total depreciation per ton of output due to this enormous concentration is very low.

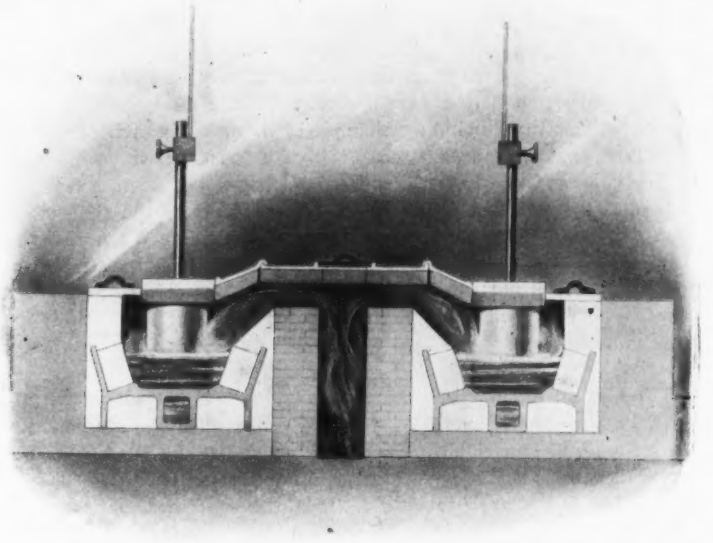


FIG. 4.—SECTION OF FUSION POTS.

It should be borne in mind that the cost of evaporating the water from a weak solution is eliminated. It is interesting to consider the future possibilities of the fused bath process. A unit employing 8000 amperes and producing nearly 600 lbs. of caustic is a comparatively small electrolytic furnace employing four anodes; therefore the process seems peculiarly adapted to working on a large scale in which still greater output per unit would be be possible. The delivery from large reverberatory furnaces of molten salt to a group of such units and the employment of the escaping hydrogen, at least in part, for melting purposes would seem to be indicated.

Train Lighting.

The Pennsylvania Railroad has put in service a train lighted by electricity, generated by storage batteries under each car. The present batteries will supply lights for twelve hours, and improvements are expected to be made whereby batteries can be installed that will furnish lights for twenty-four hours. It is said that all the through trains of the Pennsylvania Railroad will be furnished with these storage batteries.

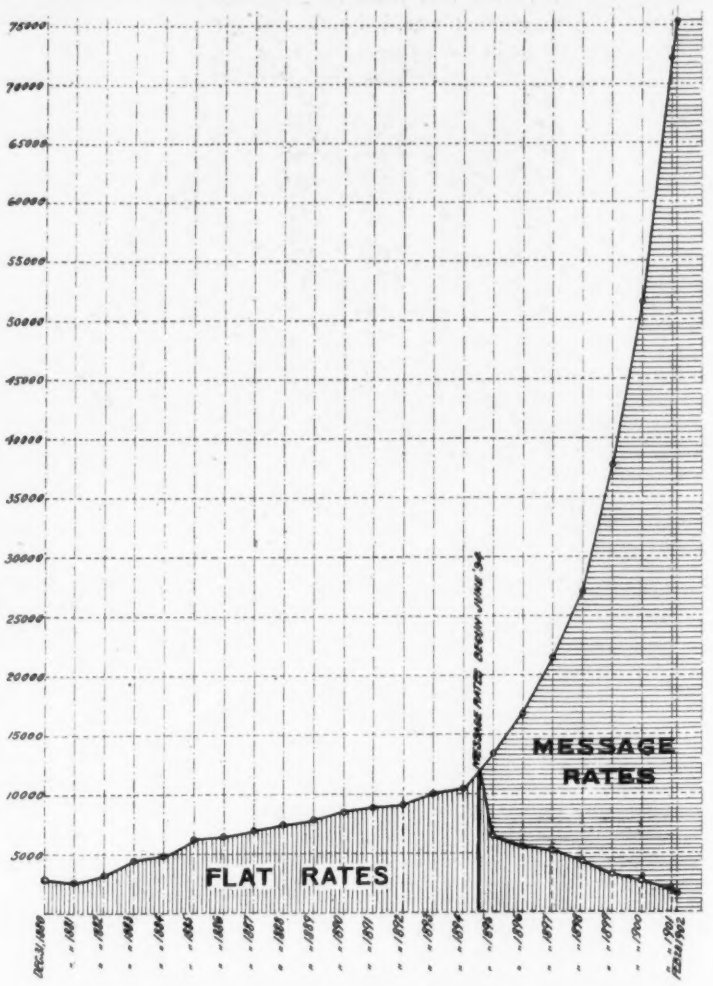
The Evolution of the Message Rate Telephone Service—I.

By Herbert Laws Webb.

On Jan. 1, 1894, the New York telephone system had less than 10,000 stations in service; to be accurate, 9914 stations, and in those days a telephone service with 10,000 stations was looked upon as a very large system, of which any city might be proud. On the first day of the year 1902, after eight years of development under message rates, the system covering the same territory—no longer the whole city of New York, but the boroughs of Manhattan and the Bronx—had 72,189 stations. And the end is not yet. Indeed, telephone men set practically no limit to the development of the telephone in large cities, and it may confidently be expected that at the end of the next period of eight years the present handsome figures will look small. The extent to which the telephone habit is being spread among the people at large is indicated by the rapidly accelerating rate of growth of the system. At the end of 1899 the total number of stations in service in Manhattan and the Bronx was 37,716, an increase of over 10,000 stations for the year, which was the first that saw the net increase run into five figures; at the end of 1900 the total was 51,571, an increase of nearly 14,000, a gain of nearly 40 per cent in the number of new stations; at the end of 1901 the total was 72,159, an increase of 20,588, again nearly 40 per cent above the gain of the previous year. On March 1 last the total stations were 75,306, as compared with 37,716 on Jan. 1, 1900, so that in twenty-six months the system has almost exactly doubled. This record is unique among the telephone systems of the world, and justifies some notes on the methods by which such rapid development has been brought about, and also on those by which it has been handled concurrently with a complete change in the operating plant. For the period of greatest increase, the past three years, during which time 45,000 stations were added to the system, has also been occupied in the change from magneto to common battery working, involving the entire reconstruction of all exchanges, the equipment of every subscriber's station, including a couple of thousand branch exchanges, with new apparatus and much work of a most laborious character on the cable plant. Every detail of this work has been carried out without a moment's interruption of the continuity of the general service, while at the same time stations have been changed at an average rate of from 2500 to 3500 a month; for it is interesting to note that to gain 1500 stations net requires usually a gross gain of about 2500, about 1000 going off the system every month from the various natural causes for changing one's arrangements that arise in this uncertain life.

The real development of the New York telephone system began in 1894 with the introduction of message rates. Previous to that year the growth had been slow, if steady, as shown by the curve, only two years, 1883 and 1885, enjoying an increase of over 1000 stations. For some five years previous to 1894 the system had been going through a difficult period of development affecting the plant solely. I refer to the change from overhead single wire working to metallic circuit underground distribution. The immense outlay incident to the sacrifice of the entire overhead wire plant, and the construction of an underground cable system of distribution and of new switchboards and subscribers' equipment, necessitated a rate for unlimited metallic circuit service considerably higher than that previously in force. The subscribers, while appreciating the improvement in the service and in general conditions effected by the change to underground working, balked at the new rate; few new subscribers came on and the old subscribers clung as long as they could to their grounded circuit contracts at the old rate. Under these conditions the system naturally increased very slowly, from 7454 stations at the end of 1888, when the removal of the overhead lines was well under way, to 9914 at the end of 1893, an increase for five years of under 2500 stations. In one year of this period, 1891, the net increase was only 209 stations, a figure which at the present time would be considered hardly a respectable week's work during the dog days. The progress made in converting the subscribers from grounded to metallic circuit working during this period was steady, but necessarily somewhat slow, as the metallic circuit rate was by no means willingly accepted by the subscribers. At the beginning of 1894 there were still over 3900 grounded circuit lines in service, equivalent to about 35 per cent of the total. This large proportion of grounded circuits seriously lowered the efficiency of the whole system and impaired the service of the other 65 per cent of the subscribers, who had metallic circuit lines, but obviously did not always get metallic circuit service. In June, 1894, the first message rate schedule was adopted, having a minimum rate of $100 a year for a party line station, with 700 messages, and a minimum rate of $150 a year for a direct line station with 1000 messages.

The telephone subscriber, as such, is universally rather a difficult customer, and is inclined to look on all innovations with suspicion, as if scenting ulterior motives. The message rate plan was an absolute novelty in New York, and while at first it was looked on rather askance by many telephone users, others found it so practical and so acceptable that quick progress was made in converting the remaining grounded circuit subscribers to metallic circuit. By the end of 1895 the system was entirely metallic circuit, the 3900 grounded circuit subscribers changing over to metallic circuit at the message rates. Moreover, so quickly did the message rate system find favor among New Yorkers, that in the year 1895 the system gained 3000 stations (equal to the total gain of the previous six years) and of the 13,345 stations in service at the end of 1895, eighteen months after the adoption of the first message rate schedule, 7016, or over 50 per



CURVE ILLUSTRATING GROWTH OF MESSAGE RATE SERVICE.

cent of the total, were at message rates. The success of the message rate scheme was therefore assured practically from the start, and within a very short time the message rates displaced the flat rates entirely from the company's tariff. A few old flat rate subscribers still retain their contracts because they prefer to take service that way, but, with these exceptions, which form a small and constantly diminishing percentage of the total stations, the entire Manhattan and Bronx system, aggregating at the time of writing over 80,000 stations in service and contracted for, is on the message rate basis.

The first message rate tariff was purely a tentative one, and as soon as it was found that the principle was acceptable to the New York public and promised to be instrumental in largely developing the use of the service, modifications were made in the rates, aiming at a reduction in the minimum rate, and as experience has been gained in the working of the message rate system and in the general operation of the plant and service a plan of rates and gradations of service has been evolved, which by its skilful adaptation to the conditions that obtain in New York, has been the main cause of the prodigious

telephone development recorded above—a development, be it said in all modesty, which is the wonder of telephone men all over the world. To describe in full the evolution of the New York rates from the first tariff of June, 1895, with a minimum rate of $150, to the present comprehensive tariff with its minimum rate of $48 a year in Manhattan, its special rates of $36 for Harlem service and of $24 a year for Bronx service, its low extension station rate, its private branch exchange rates, and so forth, would be too much of a tax on both reader and writer. The main outlines of the various steps by which the actual tariff has been reached will, however, be found interesting as a brief study in the evolution of popular telephone rates.

In general the governing idea has been directly opposed to the principle of the old flat rate method, which took the telephone line as the unit of charge and recognized but two classes of users—business and residence. In the first place the message rate scheme departs radically from the main principle of flat rates in adopting the *message* as the unit of charge, and departs from the secondary principle of flat rates in recognizing and providing for many different classes of users and for a widely varying demand as regards amount of service on the part of different users in the same general class. This great flexibility of the message rate principle is its cardinal virtue, and has been so skilfully availed of in the evolution of the New York tariff that practically any member of the public having use for the telephone service can get the kind and amount of service he requires at a reasonable rate.

In developing this comprehensive tariff from the starting point of 1894, 1000 messages at $150, the general lines followed have been the reduction of the minimum rate, the making of rates at both ends of the scale adapted to special classes of users and also to special localities, and the cheapening of the service generally by lowering the average rate per message as the system developed and the public increased its demand for telephone service. The first reduction was made in November, 1894, when the minimum direct line rate was reduced from $150 for 1000 messages to $120 for 700 messages, the party line rate remaining at $100 for 700 messages, making a difference of $20 a year between the direct and party line rates. Party line service, although it has always formed a feature of the facilities offered, has never been very popular in New York. The average New Yorker when he wants a thing seems to want it exclusively for himself, and would rather pay a little more than go shares with others. Consequently the demand for party line service has never been very great, and party line stations form but a small proportion of the total. An improved party line service is now furnished with selective ringing, which abolishes one of the most annoying features of the old party line, and at the present very low rates party lines are coming more into use than formerly. The second reduction, which was a substantial one and first brought the annual cost of telephone service in New York down to two figures, was made in May, 1895, a little less than a year after the inception of message rates. This schedule made the minimum rate $90 a year for 600 messages on a direct line, and $75 a year for 600 messages on a party line; further, it lowered the rates throughout the schedule, making necessary, since it has always been the company's policy to give to all actual subscribers the benefit of any general rate modification, the changing of all existing message rate contracts. By this time there were some 7000 message rate subscribers, nearly half the system being on message rates by the end of 1895, so that the work of changing all the contracts and at the same time caring for the new business and for the changes from flat to message rate, due to the revised schedule, was no mean operation. However, thanks to careful preliminary plans and organization, it was carried through without friction and with satisfaction to all concerned. In 1893 the company had added to its organization a contract department, charged with all direct dealings with the public regarding new business, and this department, under the volume of work caused by the introduction and development of the message rates, grew rapidly in size and scope until it is now one of the busiest offices in the company, with bases down town at Dey Street, up town at Thirty-eighth Street, at Harlem and in the Bronx. Starting in 1893 with a staff of five, including the office boy, it now has at the main office and at the branch offices a total staff of 96 agents and clerks. The contract agent is practically the company's selling agent. The curve of growth is an indication of the energy and ability displayed in enlarging the volume of business.

The next important step in the main rate schedule was taken in June, 1899, when the minimum rate for 600 messages was reduced from $90 to $75 for a direct line, and from $75 to $60 for a party line. At the same time reductions were made at various points in the schedule for larger numbers of messages. The rate, for example, for 1200 messages, which had originally been $166, and had fallen to $130, was reduced to $111. This schedule brought about a great increase in business, the growth for 1899, to half of which the new rate applied, being 10,940 stations, and for 1900, 15,287 stations, as compared with 5437 in 1898. With one modification this is the schedule in force to-day. With a view to encourage the use of the service in domestic and social life, and having regard to the small average traffic from residence stations, making them relatively cheap to operate, a special residence rate was added to the schedule. This rate gives a minimum of $66 for 600 messages on a direct line, and of $48 for 500 messages on a party line. So that at the present time you can get telephone service in Manhattan for $4 a month at your residence and for $5 a month at your place of business, rates that, say, seven years ago, few would have expected ever to see in New York, but which very probably will be improved on before another seven years roll by.

Wireless Telegraphy: Mr. Marconi's Short-Distance Work in Europe and America.

By Wilfrid Blaydes.

THE attention of the large public interested in the progress of wireless telegraphy has, for some time past, been so much directed to Mr. Marconi's long distance work that the ordinary short distance working of his system—if one may so describe its operations over distances ranging from 50 to 150 miles—is perhaps a little in danger just now of receiving something less than the consideration to which its importance and extent undoubtedly entitle it. So far, indeed, as I am aware, not even a list, with any pretension to be a complete list, of the stations engaged in such operation of the system has, as yet, appeared in the American press. I propose in the present article to give to the readers of Electrical World and Engineer some brief account of the extent to which this side of the operations of the Marconi companies has already been developed. In a future number of this journal, I shall hope to deal more exhaustively with the actual commercial position and organization of those companies.

I find, then, to begin with, that, at the present time, or rather, I should say, six weeks ago—for the extension of the system is now proceeding so rapidly that figures with regard to it soon become out of date—the stations fully equipped with and regularly working ordinary Marconi installations for wireless telegraphy over short distances—in the above definition of that term—were nineteen in number. Of these, seven are in England, one in Wales, four in Ireland, two in Canada, one in Massachusetts, one on an American lightship (Nantucket), one in Belgium, one in Germany, and one on a German lightship (Borkum). Besides these stations, others are also in operation which have been equipped from time to time by the companies, to the order of the British Admiralty. At these latter the apparatus employed is still of the old non-tuned type. The Italian Navy Department, on the other hand, has already under its control in Italy two complete installations of the latest type of Marconi apparatus. But of neither of these classes of stations, which are not worked directly by the companies, do I now write, and the big-power stations destined for transatlantic work are equally outside the scope of my present intention.

Turning, then, first, to the English stations, they are:

(1) Withernsea, a point on the Yorkshire coast not far from the Humber and the port of Hull, and favorable, therefore, for communication with ships passing up and down the North Sea.

(2) Caistor, on the Norfolk coast, a little to the north of Yarmouth, a site selected, like Withernsea, in view of the North Sea traffic.

(3) Frinton, in Essex. This station is of considerable and growing importance, chiefly by reason of the fact that in connection with it a technical school has been established where instruction is now provided by the companies for the practical training of their staff of operators. It is in the working of the system between this station and

(4) The North Foreland, that the assistants now gain their first experience of its methods. The North Foreland station is also, of course, in regular use as a ship-signaling and ordinary commercial station, being within easy call, especially, of the Belgian mail packets,

on which the system has for some time past been in successful everyday employ. The most important of the English stations are, however, the remaining three, which are in the English Channel, at, respectively, (5) Niton, Isle of Wight, (6) North Haven, at the mouth of Poole Harbor, and (7) the Lizard.

Of these, North Haven is mainly an experimental station, and some of Mr. Marconi's earlier experiments, long before his system had reached its present point of development, were there carried out. Worked in conjunction with Niton, which is quite near—only thirty miles away—and with the Lizard (200 miles), Mr. Marconi still makes considerable use of it in connection with the experimental side of his work, to which no new achievement ever leads him to attach less than the first importance. The two stations at Niton and the Lizard include within the radius of their operations practically the whole of the English Channel. The Lizard station will thus "pick up" a ship as she leaves Southampton Water, maintain communication with her throughout her trip across to Cherbourg Harbor, and not lose it until she is safely out of the Channel and is 150 or 160 miles west of Cornwall, on her voyage to New York.

Of the four Irish stations, two (8) Inistrahull, and (9) Malin Head, are operated by Lloyds for the purposes of their signalling stations at those points.

(10) Crookhaven, in County Cork, near Brow Head at the southwestern extremity of Ireland, is usually the first station to get into touch with inbound, as it is the last to lose it with outward-bound Atlantic steamers. This station has also more than once been used by Mr. Marconi in connection with the earlier stages of his long-distance experiments.

(11) Rosslare, in County Wexford, and (12) Holyhead divide between them the signalling and ordinary message work between shore and ships passing to and fro in the Irish Sea and St. George's Channel.

(13) Belle Isle and (14) Chateau Bay are two stations established by the desire of the Canadian Government for signalling and general commercial purposes on the Straits of Belle Isle at the northern entrance to the Gulf of St. Lawrence.

(15) Siasconset is the station on the American mainland which was erected by the *New York Herald* for work in conjunction with the installation (16) on the Nantucket lightship.

(17) La Panne is the company's Belgian station, which the work in connection with the Belgian mail packets, plying daily between Belgium and England, would alone suffice to keep fairly busy.

(18) Borkum Riff in Germany and (19) Borkum lightship, finally, are a pair of stations similar in character to the Siasconset-Nantucket installations. They are worked by the Norddeutscher-Lloyd.

Besides these nineteen stations in regular work, the companies have actually in hand the establishment of some seven other similar installations for the use of Lloyds at their signalling stations. One pair of these is to connect the Flannan Islands with the Butt of Lewis in the Hebrides. Others are to be erected at Cape Spartel in Morocco, at Port Said and Suez, and at Shadwan Island and Tor in the Red Sea.

Of the working of the Marconi system in this relation, that is to say, as an adjunct of the world-wide system of ship-signalling which is controlled by the corporation of Lloyds, I may, perhaps, deal in somewhat fuller detail in a subsequent article. In this place I wish merely to call attention to the fact that under the formal agreement concluded some little time ago between that corporation and the Marconi International Marine Communication Company, Ltd., the system of wireless telegraphy controlled, in respect of the class of work in question by the latter (so that, for accuracy, I should rather have written "company" than "companies" a few lines back) is adopted exclusively for use in connection with the Lloyds signal stations for a period of fourteen years, and the installations at such stations are also available for the ordinary passenger and commercial traffic of the company. The importance of the first of these provisions, in particular, may not easily be overrated. It means that for a period of at least fourteen years no ship carrying wireless telegraphic apparatus, other than the Marconi apparatus, will be allowed to communicate by wireless telegraphy with a Lloyds station in any part of the world, any more than it is able so to do with stations under the direct control of the Marconi Companies, from all communication with which such ships are, naturally, debarred altogether. Since practically no wireless telegraphic land stations have hitherto been established by those interested in other systems than Mr. Marconi's, the almost absolute monopoly of mercantile marine signalling and sea telegraphy is thus assured for some considerable time to come, at any rate, to the Marconi system, and as the directors of the Marconi Wireless Telegraph Company, Ltd., point out with very legitimate satisfaction in their last report, its instruments must accordingly now be considered the standard instruments for the ships of all nations.

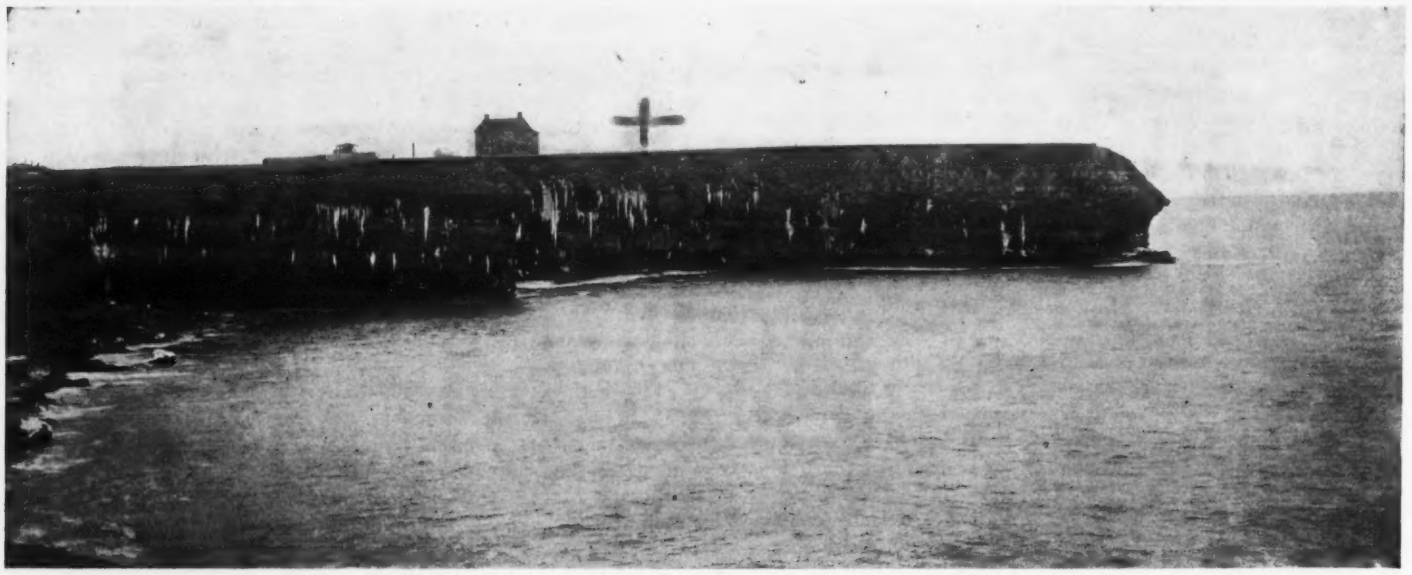


TABLE HEAD, GLACE BAY, CAPE BRETON.

(*The cross indicates the site to be occupied by Mr. Marconi's new transatlantic station.*)

I should be sorry to do an injustice to the distinguished Herr Professor Slaby, of Charlottenburg, and his collaborator Count d'Arco, and it occurs to me that I may possibly have been guilty of one in my remark just now that at present practically no other than Marconi wireless telegraphic land stations are anywhere in existence. Since writing it, I have read a report that appeared in the *New York Herald*, upon the voyage of the *Deutschland*, as that good ship the other day bore Prince Henry back from New York to the Fatherland. This has reminded me that a pole has indeed been erected at Cuxhaven for the purpose of working a wireless telegraphic system which has come to be known as the Slaby-d'Arco system.

I notice in the same report to which I have alluded that, on the occasion in question, the German Emperor, anxiously awaiting his brother on the quay, at length, thanks of the genius of the Herr Professor Slaby and Count d'Arco, did actually receive news of the *Deutschland* (which, of course, had passed up channel without being able to communicate with any of the Marconi stations) when she was at a distance which was alleged to be ninety miles from port. Where-

upon, seeing that he had time and enough to spare, his Imperial Majesty, with a sterling common sense which must appeal to us all, hied him blithely away to dine. Unluckily, however, the alleged ninety miles turned out to be, in fact, twenty, and the Emperor's dinner, and, if he be at all human like the rest of us, his temper no less, suffered accordingly some rude disturbance. One can only trust that the Slaby-d'Arco station at Cuxhaven is occasionally somewhat less erratic, not to say, humorous, in its operations. The little story, nevertheless, may possibly throw a certain light upon some recently reported tests at Kiel, during which Slaby-d'Arco messages were received over a distance also, curiously enough, alleged to be between eighty and ninety miles, whereas the utmost distance achieved by the poor, out-of-date Marconi system during the same series of tests was stated to be something over fifty miles. This, too, if I am not mistaken, in the very week when Mr. Marconi, on board the *Philadelphia*, was receiving duly authenticated messages from England over a distance of 1551 miles!

The report of this German testing of different systems at Kiel, I may as well mention, was, so far as the Marconi Companies are concerned, entirely devoid of foundation. They took no part in, nor received any notice of, any such competition, as the report suggested, and, I may hazard it as my private opinion that, in any case, they would not improbably have respectfully declined to take part in the proceedings described. Further comment on these is needless, but those holders of cable stock who may have been caused to suffer some little uneasiness by Mr. Marconi's proceedings, may perhaps be expected to direct their consideration with some relief to the wireless system of telegraphy which is associated with the names of the brilliant German professor and his noble ally.

A word or two will be in place here as to the Cape Breton station just selected. After Mr. Marconi had considered the respective advantages of several points on the coast between Sydney and Louisburg, to enable him to visit which with convenience the Dominion Coal Company courteously placed a special train at his disposal, he finally selected as being, on the whole, the most suitable for his purpose, a grassy promontory named Table Head, situated some two miles north of Glace Bay. To a considerable extent, this spot presents a favorable combination of the two classes of conditions—electrical on the one hand and engineering on the other—which have chiefly to be taken into account in the choice of sites for wireless telegraphic stations. It is accessible with tolerable ease, the regular line of the Louisburg & Sydney Railway being within a distance of two miles. A freight track, connecting with the above, and also the property of the Dominion Coal Company, at present passes within about two hundred yards of the site, and the company has furthermore undertaken to run a branch line up to the very doors of the station—no unimportant consideration where the transport of heavy machinery and apparatus is in question. There is, furthermore, an excellent water supply, and the building contractors (Rhodes, Curry & Company) expect to have the erection of the towers completed within a couple of months. Mr. Marconi leaves Mr. R. N. Vyvyan as resident engineer in charge of the installation of the plant, and, if all go well, it is expected with some confidence that everything will be completeed and the station ready for work before the summer of the present year is far advanced.

Needless to mention, the town of Glace Bay, where much interest has been taken in the matter since it was first mooted, is jubilant over the decision in its favor as the locality for the new station. The hopes of Louisburg ran high, but for various reasons they had to be disappointed. Throughout his visit to Cape Breton, Mr. Marconi received many testimonials of the hearty good will of the inhabitants, Mayors and town councils vied with each other for the opportunity of entertaining the modest, unassuming young man who has already made such a deep mark upon the scientific history of his time. Upon his arrival at Sydney from Ottawa, Mr. Marconi was, indeed, the object of something resembling an ovation from the local Italian colony, which assembled to greet him at the railway station and, despite the lateness of the hour and the persistent rain, escorted him to his hotel with a torchlight procession and ringing Italian "Evvivas."

The Pan-American Tower.

It is stated that the famous electric tower of the Pan-American Exposition has been sold to the city of Denver, whither it will be removed as soon as practicable and placed in a park there as a permanent feature.

The Independent Telephone Movement in Philadelphia.

THE city of Philadelphia has been from time to time the center of movements for the establishment of independent telephone exchanges, and the memories of many of our readers will doubtless go back to the time when in opposition to the Bell system there a Clay telephone service was in active operation. The recent revival of independent telephony due to the lapse of the controlling Bell patents has naturally been marked by action in Philadelphia, and for some months past the Keystone Telephone Company has been actively at work preparing to give service. We are now able to present some details of this work up to date.

The Keystone Telephone Company was organized in April, 1900. Its franchise was granted on April 19, 1900, authorizing the company to lay conduits, erect poles, lines, buildings, etc., and maintain and operate a telephone system in the City and County of Philadelphia. In May, 1900, Dr. Louis Duncan was employed to prepare preliminary plans and make an estimate on the probable earning capacity of the plant. On the basis of this estimate, the company decided to proceed with the work and a corps of engineers was employed to prepare de-

FIG. 1.—GENERAL OFFICE BUILDING, EXTERIOR.

tailed plans and specifications covering the underground work, cables, lines, buildings, switchboards, instruments, etc. In February, 1901, the company's capital was increased from $2,000,000 to $10,000,000.

Work was begun on April 25, 1901. During the year 1901, the company laid 4,250,000 duct feet of underground conduit in the central portion of the city, covering 75 miles of street; built 1250 manholes, and constructed one building 95x135 feet, 5 stories high, at 135 South Second Street. This building is used as the company's general offices and exchange to supply that portion of the city lying east of Eleventh Street and south of Fairmount Avenue. This is known as the "Main" exchange. The company has also constructed a building at Sixteenth and Summer Streets, 45x120 feet, 4 stories high, for an exchange to cover that portion of the city between Eleventh Street and the Schuylkill River, and south of Fairmount Avenue. This is known as the "Race" exchange. Both buildings are of brick and terra cotta, and fire-proof construction throughout. Both exchanges are of the same capacity, 3480 lines installed, and an ultimate capacity of 7200 lines. The switchboards are of the central energy system, manufactured by the Kellogg Switchboard & Supply Company, on specifications of the engineer of the Keystone Tele-

phone Company. The instruments are those the American Electric Telephone Company, of Chicago, made on specifications furnished by the Keystone Telephone Company.

The "Main" exchange board has been in operation about thirty days. The "Race" district board will be in operation on May 1. Both exchanges will be in operation in practically one year from the date the ground was broken. The contract for furnishing and installing all the main cables was let to the American Electrical Works, of Providence. All cables in the "Main" district are now completed. about 1000 telephones are in operation, and about 50 telephones are being added daily. We have before us the March subscriber's list

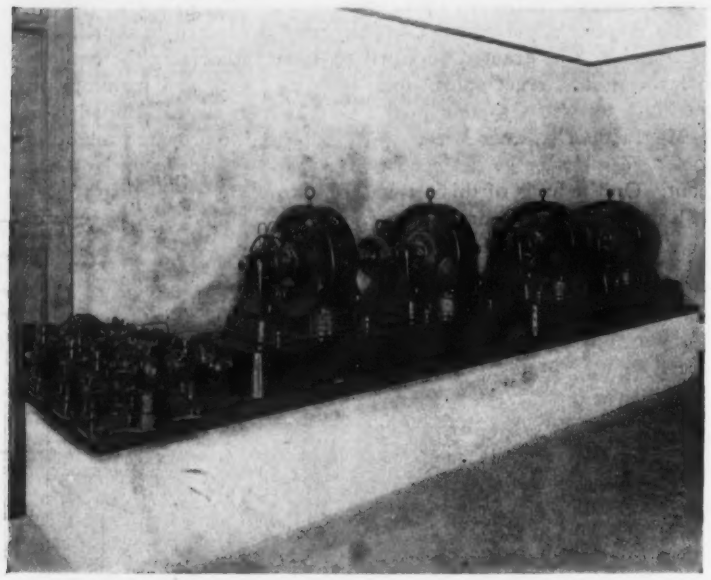


FIG. 2.—MOTOR-GENERATORS.

of some 20 closely printed pages of names. It now has upwards of 9000 five-year contracts for service.

In general, the apparatus which was installed consists of fifteen sections of multiple switchboard (each section consisting of six panels and being arranged for three operators' positions), one main distributing frame, one intermediate distributing frame, one relay rack which is used for mounting the relays in the line circuits, one relay rack for mounting the relays in the incoming trunk circuits, chief operator's desk, wire chief's desk, manager's desk, and information desk, and a complete power plant. The multiple switchboard at present consists of four trunk and eleven subscribers' sections. Each section is arranged with apparatus for three operators, and has a capacity for 7200 subscribers' multiple jacks, 240 outgoing trunk jacks with designation strips, and 300 answering jacks and answering lamps. A cable turning section is placed against the wall which separates the switchboard room from the terminal room. From this cable turning section, the switchboard sections grow in a direction from left to right. The four sections nearest to this cable turning section are incoming trunk sections. At the first position are located the trunk lines from the chief operator's desk and the wire chief's desk. The remaining eleven positions in these sections are each arranged for an incoming trunk operator with 30 plug terminated incoming trunk lines. The first four of these eleven positions have not been furnished with equipment with this installation. The remaining seven positions are each completely equipped. Arrangement has been made for switching all incoming calls received at any one of these positions to any desired position. By this arrangement, one operator can handle all of the incoming business of the exchange during the night or the slack times of the day.

The fifth to the fifteenth sections are each arranged for an equipment for three subscribers' operators with 15 pairs of connecting cords and 10 order wire circuits. Each position, excepting the last one in the fifteenth section, has been completely equipped. Each cord equipment consists of two supervisory lamps, a listening key and a two-party indicating ringing key. Each of the fifteen sections is provided with an equipment of 3420 subscribers' multiple jacks, 240 outgoing trunk jacks, 320 answering jacks and lamp jacks. The multiple lines are multiplied once in every section and the outgoing trunk lines are multiplied once in every two sections. The first and last subscriber's operator in each section is furnished with 100 answering jacks and 100 lamp jacks. The middle operator's position at each section has an equipment of 120 answering jacks and lamp jacks. One pilot lamp is located at each incoming trunk operator's position and two at each subscriber's operator's position. The lamp at the trunk operator's position lights whenever an incoming call is received at a position when the operator's telephone plug is not inserted in the telephone jack; one pilot lamp at each subscriber's operator's position lights whenever any line lamp at that position is lighted, and the other pilot lamp at the subscriber's operator's position lights at the end of conversation when the clearing out lamp which is associated with the answering cord is lighted.

The chief operator's desk is provided with circuits for calling and conversing with the superintendent or manager; for conversation between the chief operator and any subscriber and with any other desk operator, and with circuits which notify the chief operator of the rapidity and accuracy of the work of all of the exchange operators. The information desk and the manager's desk are each provided with three regular exchange lines and one line to each one of the other desks in the exchange. The wire chief's desk is provided with apparatus for testing any line in the exchange, and for determining the nature and location of any trouble which may arise on these lines. It is also provided with circuits which enable the wire chief to converse with any exchange operator, with any subscriber and with the chief operator, information operator or manager.

The terminal room adjoins the switchboard room. The terminal frame, main and intermediate distributing frames and relay rack are parallel to each other and are located as near to the switchboard as possible. The terminal frame is of a size large enough to accommodate fifty-two 100-pair cable heads, but arrangement has been made so that additional iron work can be added later and the size increased so as to accommodate cable heads for the ultimate number of lines. The present equipment consists of the complete equipment of 52 cable heads. The main distributing frame provides for an

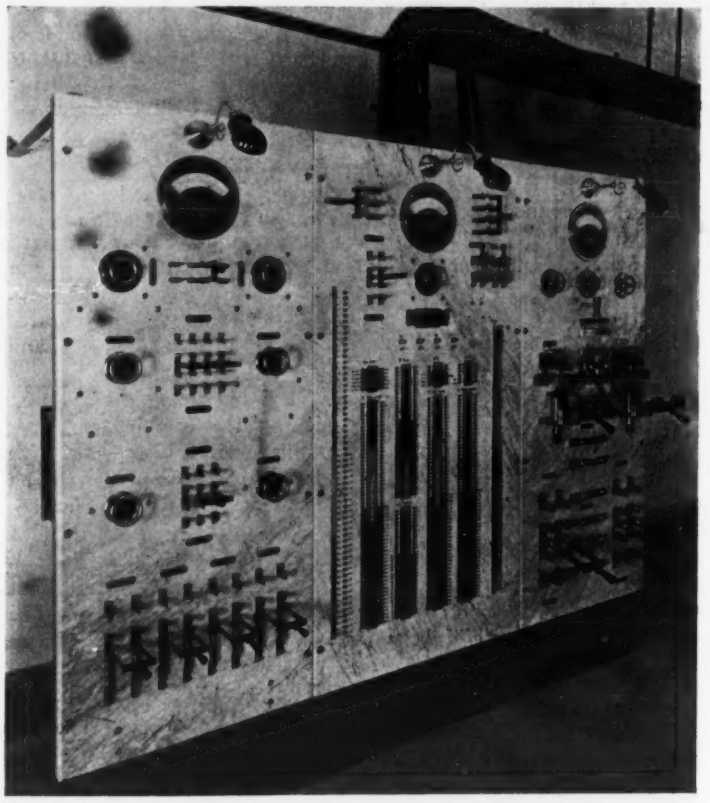


FIG. 3.—POWER BOARD.

equipment of 4480 lines with provisions for growth. The present equipment consists of terminals on both the line and switchboard uprights for 3500 subscribers' multiple lines, 540 outgoing trunk lines, 280 incoming trunk lines and 20 miscellaneous lines. The frame work for the relay rack which is provided consists of iron work for 18 bays, each having a capacity for 200 pairs of line and cut-off relays and two strips of retardation coils, which are used in connection with the outgoing trunk lines. Arrangement has been made so that the size of this rack can be increased when desired. The intermediate distrib-

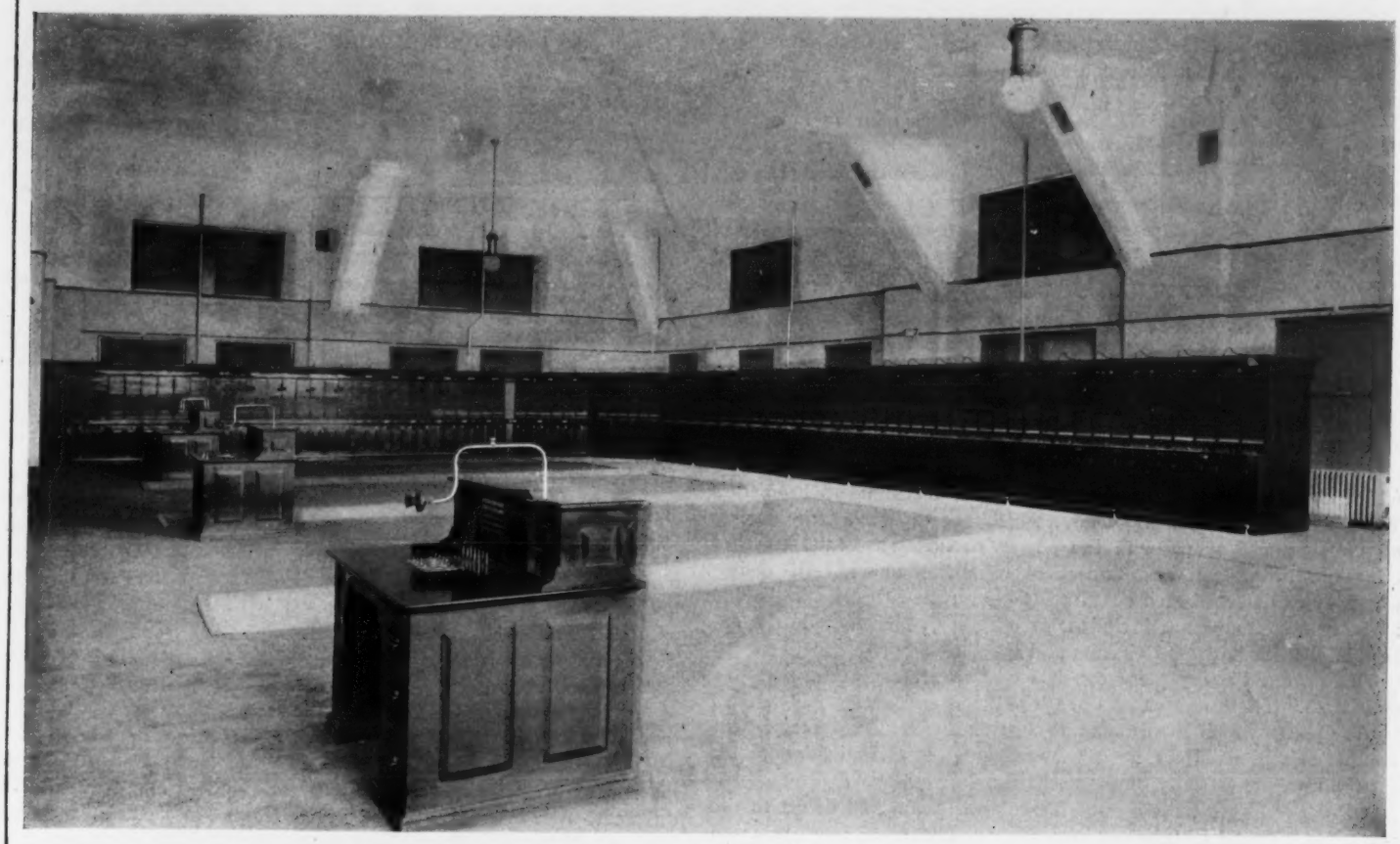


FIG. 4.—SWITCHBOARD MAIN EXCHANGE.

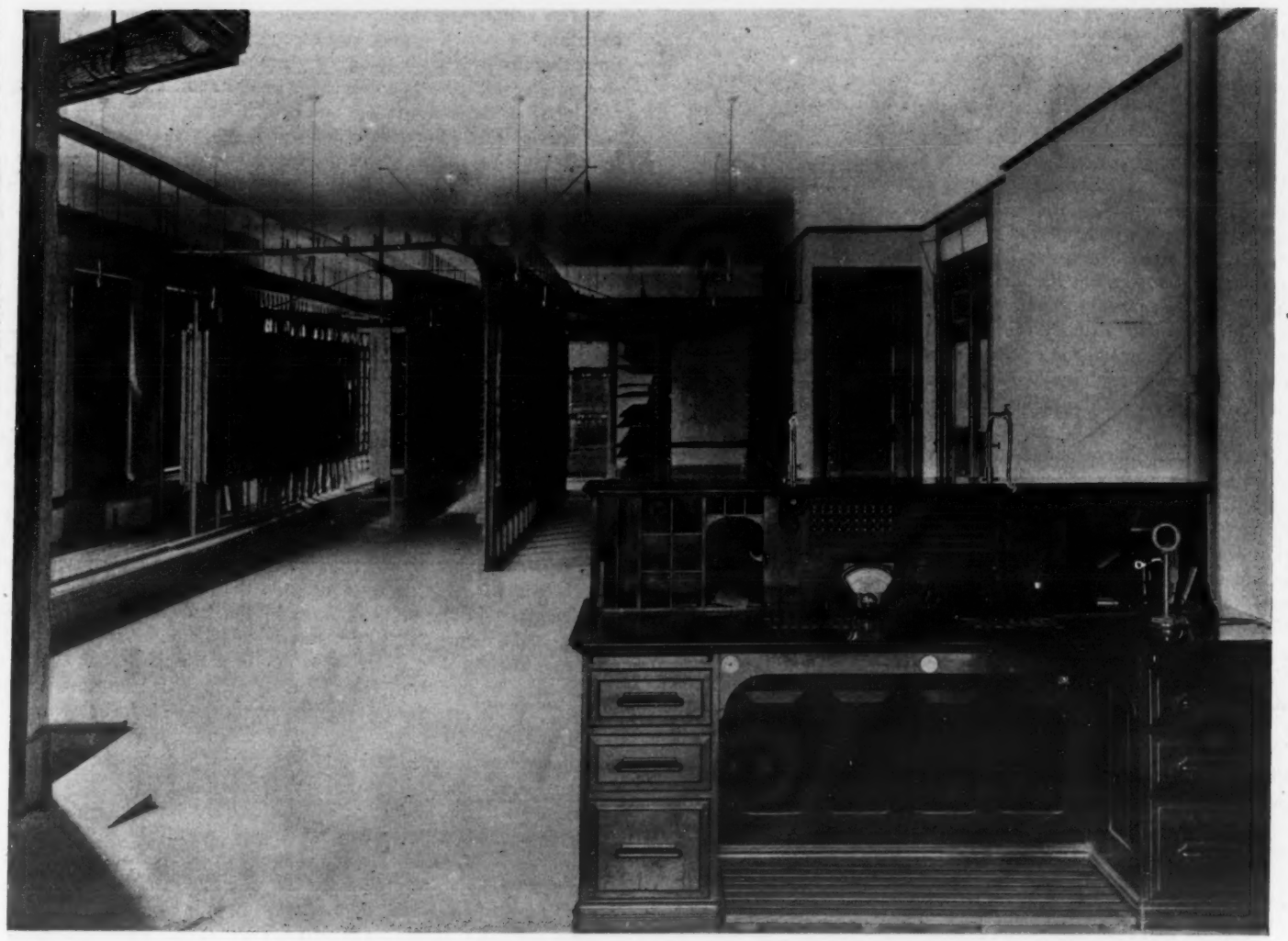


FIG. 5.—TERMINAL ROOM.

INDEPENDENT TELEPHONE EXCHANGE IN PHILADELPHIA.

uting frame provides for a capacity for 3600 lines. The present equipment consists of the complete equipment of terminals on both the line and switchboard uprights. The trunk relay rack has a capacity for the relays required in the incoming trunk circuits for 12 incoming trunk operators.

The entire power plant, with the exception of the storage batteries, is located in the terminal room; the batteries are located in an adjoining room. Two Holtzer-Cabot special wound telephone generators have been provided for charging the storage batteries; each is run from the primary source of power, at 220 volts direct current.

Three ringing dynamotors, with "busy back" and "don't answer" attachments have been furnished. Two are wound to run on the 220-volt mains and the third is wound to run by current from the storage batteries. The ringing and charging machines are located on a machine pier made of white enameled brick. The power switchboard and fuse board are mounted in one iron frame and are made of polished marble. The power board is provided with copper switches which enable all desired changes in the power circuits to be made; Weston voltmeters and ammeters, which are capable of measuring all voltages and currents in the power circuits, rheostats, starting boxes and over-load and underload circuit breakers. All fusing of power and switchboard circuits is done on the fuse board. Under switchboard circuits are included, the circuits which include the relays in the line and cord circuits and the line lamps.

The storage battery plant consists of two sets of batteries of 11 cells each. The battery tanks are lead lined and are provided with battery plates which are capable of supplying current for the present number of equipped lines, but are large enough to accommodate plates for the ultimate capacity of the exchange.

All of the larger buildings in the city are connected direct to the underground cables. The smaller ones are connected from junction boxes on the rear building walls. The company has no poles, and it is not the intention to erect any poles except in the suburban parts of the city. The wisdom of this method of construction was proven in the recent storm, when all telephone and telegraph communication in that city was destroyed for about ten days. The Keystone Company suffered no damage whatever. All main conduits used were of the 4-multiple type with 3½-inch square hole in 3 feet lengths, laid in concrete. Lateral conduits are of creosoted wood.

The company is building an exchange at Filbert and Preston Streets, West Philadelphia. Switchboard and instruments have been ordered, as well as the conduits and all other material excepting cables, and orders for these will be placed shortly. It expects to construct during the year one exchange at Tenth and Susquehanna Avenue, one in Germantown and one in Kensington, making a total of six exchanges in Philadelphia County. The West Philadelphia exchange will have an ultimate capacity of 2880 lines and 960 lines installed. The Germantown and Kensington exchanges will be duplicates of the West Philadelphia plant. The North exchange at Susquehanna Avenue will be a duplicate of the "Main" exchange. This year's work will require the laying of about 5,000,000 feet of conduit.

The rates of the company for service are: Unlimited business telephones per anunum, $84; unlimited physicians' telephones per annum, $64; two-party line business telephones, $52; direct wire residence telephone, $48; two-party line residence telephones, $36; extension desk sets, $10. The officers of the company are well known men, whose names in some instances have been prominent in recent traction developments in Philadelphia. They are: President, Robt. H. Foerderer; vice-president, Jacob E. Ridgway; secretary and treasurer, W. H. Clark; general manager, C. E. Wilson; directors, R. H. Foerderer, Norman Grey, John M. Mack, Michael Murphy and J. E. Ridgway.

The company has a traffic agreement with the Keystone State Telephone & Telegraph Company, which gives it connection with the surrounding territory. That company is building in all suburban points around Philadelphia, and is building lines to connect with the principal exchanges in other cities. Submarine cable across the Delaware River will be completed in about two weeks, giving connection with Camden and all points in Camden and Gloucester counties, New Jersey, and the line is being surveyed to Atlantic City and Trenton to give connection with the Interstate Telephone Company, of New Jersey, who control practically all of the independent telephone plants in the State of New Jersey.

The connection with the lines of the Maryland Telephone & Telegraph Company affords relations with all of the independent companies in Maryland and Delaware.

A Telephone Evening at the Institute.

At the 163d meeting of the Institute, held at 12 West Thirty-first Street, New York City, Friday evening, March 28, 100 members and guests were present. A meeting was also held simultaneously in Chicago.

The general subject of the meeting was "Telephony," and was introduced by President Steinmetz, who outlined the electrical features of long distance telephonic transmission. Mr. Arthur Vaughan Abbott, of New York City, presented a paper on "The Telephonic Status Quo." A paper by Mr. Franz J. Dommerque, of Chicago, was read by Mr. William J. Hammer, in the absence of the author. The title was, "Telephone Rates from the Engineers' Point of View." At the Chicago meeting a third paper was read by Mr. Angus Hibbard, entitled, "Telephony—1902." Abstracts of these papers follow:

THE TELEPHONIC STATUS QUO.

In the preliminary paragraphs of the paper with the above title read by Mr. A. V. Abbott referred to the policy of reticence maintained by the Bell Company with respect to the technical features of its system and the manner in which its guarded knowledge relating to the manufacture of its apparatus, which not only impeded progress but gave rise in the public mind to various suspicions. People saw only an insignificant bit of apparatus which their common sense told them could be made for a dozen dollars, for the annual use of which a charge of from $50 to $250 was made. Small wonder, then, in view of this insufficient evidence, that on the expiration of the fundamental patents, there were hosts of enterprising electricians (many of them of the locksmith and bell hanger type) who were ready to flood the market with telephonic apparatus of all kinds, good, bad and indifferent; nor that there was a public trained and educated to embrace any telephonic relief from the real or fancied oppression of a so-called grasping monopoly.

Mr. Abbott, after saying that it is no part of his paper to examine into the validity of the grounds for this state of public sentiment, maintains it exists, deeply and strongly rooted in the public mind, fixed therein by nearly a score of years of most unfortunate training; so firmly seated that in some cases independent exchanges, charging regular rates, have flourished and grown fat in the face of absolutely free service offered by the older company, in the hopes of crushing by the superior endurance of a powerful backing, their younger and seemingly weak rivals. So strong is this sentiment that to-day, though the Bell companies are nearly a quarter of a century old, and the Independent companies barely six years, the field is quite evenly divided between them as is shown by the statistics in Table I.:

TABLE I.

Item.	*Bell.*	*Independent.*
Invested capital	$320,000,000.00	$150,000,000.00
Number of exchanges	1,500	2,811
Sub-stations	1,080,000	1,198,000

During the past year about $18,750,000 has been spent on telephone apparatus, of which about 40 per cent is credited to the Independent interests, and in this field 415 new Independent telephone companies have been floated.

It is possible to-day for anyone to build a first-class telephone exchange, and with good care, shrewd and expert management, to give service that cannot be excelled at the lowest possible price. While this is possible, it is rarely done. On the contrary, a very erroneous idea prevails in the mind of most of the Independent companies as to the requirments and limitations of telephony. According to their doctrine, all one has to do is to put in a telephone (any kind of a telephone) build a line (any kind of a line), set up a switchboard (any kind of a switchboard), go away and leave it to its own devices, returning once a year to collect the dividends. The general manager of a 5,000 line Independent exchange recently remarked in answer to a question as to cost of maintenance, *"why,* we don't have any maintenance, we have a new plant." Another gentleman, president of more than one telephone company, when advised to allow $2.00 per substation per year for maintenance expense, averred that ten cents per year was amply sufficient for the purpose.

After referring to the haphazard way in which Independent companies are often organized and to the manner in which they put down a plant, and to the reckoning bound to come with a turn in our present era of prosperity, Mr. Abbott said that if only the cloud of mystery that has for so long obscured telephonic practice was dispelled, and the public taken fully into the confidence of the operating company,

much of the present friction would be obviated. People would gain not only true appreciation of the service performed for them, and so be more tolerant of tariffs, but would also acquire such a knowledge of the telephonic *modus operandi* as to vastly increase the efficiency of every telephone plant. In this respect, the Independent companies are setting an admirable example. Frequent conventions take place, at which free and open discussions of all subjects of interest are held, to which all, whether friend or foe, are equally and cordially welcomed. Each week the technical papers of the land chronicle all items of progress in so free and full a manner as to display the most striking contrast to the years of grim and forbidding silence maintained by the older organization.

Mr. Abbott says that there appear to be five results which are certain to follow from the present situation:

1. Many of the present organizations lacking in experience and strength, located in unpromising fields will go down with the first of the present. If the Bell companies heed the tendencies of the times, they may yet not only retain, but revive a fast diminishing supremacy. Failing in this respect, they will be forced to meet this just demand, either by the struggle for existence in the face of fiercest competition; or by the pressure of ordinance regulations, as has recently been witnessed in Chicago; or by such legislative action as will declare all telephone companies to be common carriers, and compel each to handle and transmit to its own subscribers any messages delivered by the other.

Mr. Abbott then takes up the subject of rates, and states that in giving service, telephone companies do three entirely separate and independent things which are incommensurable with each other, all of which every just and equitable tariff must recognize and express.

1. The telephone company supplies and maintains a certain amount of apparatus necessary to connect each subscriber with the central

TABLE II.—GENERAL TELEPHONE STATISTICS.

	Name of City.	Population	No. of Telephones	Per cent of Telephones	WIRE MILES. Underground.	Aerial.	Total	Per Telephone	TARIFF. Flat Rates. Business Telephones. 1 Party $	2 Party $	4 Party $	Multi Party $	Residence Telephones. 1 Party $	2 Party $	4 Party $	Multi Party $
B	Baltimore....	507,000	6,300	1.25					125	100			100	78	60	
I	"	"	6,000	1.25	1,140	757	1,897	.3	48	42	32		36	30	24	
B	Boston.....	560,892	23,106	4.1	47,000	7,400	54,400	2.3	162	141			116	102		
B	Buffalo	352,219	9,449	2.7	6,830	5,475	12,305	1.3								
B	Chicago.....	1,698,575	37,969	2.2	108,633	33,190	141,823	3.8	175				100	75	60	
B	Cleveland....	381,000	13,744	3.5	28,623	13,119	41,742	3.2	84	72			60	48		
I	" ...	"	9,000	2.4	9,000	4,500	13,500	1.4	48				36			
B	Columbus....	125,560	8,500	6.8	7,964	8,164	16,128	1.9	40				24			
B	Indianapolis .	169,000	4,537	2 7	9,600	12,500	22,100	4.8	40				24			
B	Kansas City..	163,000	7,200	4.4	6,500	7,500	14,000	1.05	96	75	51		72	60	42	
B	Louisville....	204,731	6,604	3.2					96	78	48	36	60	48	30	18
I	"	"	5,000	2.5					48				36			
B	Minneapolis..	202,000	9,025	4.5	11,859	7,655	19,514	2.15	84	72	54	18	60	48	36	18
B	Milwaukee...	285,000	8,900	3.1	12,529	5,559	18,088	2.0	96	72	60		60	48	36	
B	Nashville.....	86,000	3,498	4.0		1,030		.29	84	48	36		54	36	24	
B	New Orleans.	287,000	6,000	2.1					120				60			
B	New York....	1,850,000	63,975	3.5	152,807	2,455	155,262	2.25	240							
B	Omaha..... .	102,000	3,851	3.7	3,571	1,758	5 326	1.4	90	72	48	24	66	48	36	
B	Phiadelphia..	1,400,000	23,438	1.7	72,618	7,808	80,426	3.5	160							
I	" ..	"							80	52			48	36		
B	Pittsburg	451,512	11,986	2.5	22,388	13,227	35,615	3.0	125	100	80		100	80	60	
B	Rochester....	162,608	4,200	2.6	11,550	800	12,350	3.0	94	64			36	24		
I	"	"	4,200	2.6	3,324	2,011	5,335	1.25	48				30	24		
B	San Francisco	342,000	29,135	8.5	23,565	7,100	40,665	1.4					66	60		
B	St. Louis.....	575,238	7,851	1.4	8,465	11,940	20,405	2.6	150	100			72	48		
B	St. Paul.....	166,000	5,715	3.5	7,356	3,297	10,653	1 9	84	72	54	18	60	48	36	18
I	"	"	1,314	.8					48				30			

	Name of City.	TARIFF. Measured Service. Business Telephones. 1 Party $	2 Party $	4 Party $	Multi Party $	Excess Calls. $	Com. Box. $	Residence Telephones. 1 Party $	2 Party $	4 Party $	Multi Party $	Excess Calls. $	Com. Box. $
B	Baltimore....					.06		1000 c 72	1000 c 62	1000 c 48		.04	
I	"						.05				365 c 18.25	.05	.05
B	Boston.....	1000 c 90	1000 c 75	1000 c 66		.04		1000 c 90	1000 c 75	1000 c 60		.04	
B	Buffalo	1000 c 70				.06		1000 c 52					
B	Chicago.....	1000 c 92	1460 c 73		1000 c 48	.05	.05	1000 c 92	1460 c 73	1000 c 48	395 c 18.25	.05	.05
B	Cleveland....	1000 c 60	1000 c 48	1000 c 36		.03	.05						.05
I	" ...						.05						.05
B	Columbus....												
B	Indianapolis .												
B	Kansas City..	1000 c 72				.05	.05						.05
B	Louisville....	1000 c 74				.05						.015	
I	"							1000 c 60					
B	Minneapolis..	1000 c 72	1000 c 62	1000 c 48		.03						.03	
B	Milwaukee...	1000 c 68	1500 c 60	1000 c 50		.02	.05	1000 c 48	1000 c 36			.02	.05
B	Nashville.....	1000 c 41				.05		1000 c 33				.05	
B	New Orleans.												
B	New York....	1000 c 99	1000 c 87			.08		1000 c 90	1000 c 87	1000 c 78		.07	
B	Omaha..... .	1000 c 72				.04		1000 c 72				.04	
B	Phiadelphia..	1000 c 78	1000 c 66			05		1000 c 69	1000 c 60	400 36		.05	
I	" ..												
B	Pittsburg	1000 c 70				.04		1000 c 70				.04	
B	Rochester....	1000 c 70				.06		1000 c 36				.04	
I	"												
B	San Francisco	1000 c 140	1000 c 104		365 c 18.25	.05					365 c 18.25	.05	
B	St. Louis.....	1000 c 69	1000 c 57			.04		1000 c 57	1000 c 5			.04	
B	St. Paul.....	1000 c 60				.03						.03	
I	"												

NOTE.—This table is compiled from various sources and is believed to be fairly accurate within about six months.
In the first column the "B" and "I" signify Bell Plants and Independent Plants, respectively. Under Measured Service the letter "c" signifies "Calls."

monetary stringency, throwing by their ruin considerable disfavor on the financial aspect of telephony.

2. The remaining Independent companies will be forced to adjust their rates until such a point is reached as to enable them to become investments of reasonable earning power, and to this end only the most carefully designed, best constructed and shrewdest managed plants can possibly survive.

3. The rates of the Bell companies must fall until both the Bell and the Independent meet at a common level and thereafter, so far as the public is concerned, it matters little which gives service.

4. The Independent companies are weak in their lack of coherence, feeble in possessing but few exchanges in the larger towns, and almost none in the great cities, and powerless in the toll and long distance field. New York is the keystone of the telephonic arch, and when that city is captured by an Independent company, the battle will be more than half won, but judging from recent developments in this direction, that time is still in the somewhat far distant future.

5. An extensive and far-reaching tariff revision is the vital question office. This apparatus must be furnished and cared for whether used or not, merely to give the subscribers an *opportunity* to call. The quantity and quality of this apparatus does not vary with the load, being the same whether the instrument is used once a year or 100 times a day. A flat rate annual tariff sufficient to pay interest, depreciation and maintenance on this portion of the plant is fair and just, and by recognizing varying lengths of subscribers' lines, this charge can be made exactly proportional to the requirements of each station.

2. The telephone company must maintain a corps of operators to answer subscribers' calls and to perform the necessary avocations of connecting subscribers together. This expense is directly and only proportional to the number of *times* each station calls.

3. During each conversation, battery is supplied to the subscriber's station for talking, cords, plugs, trunk lines and other common apparatus is in use, the amount and cost of which is proportional to the length of time of conversation.

Therefore, any telephone tariff to be fair to all, must recognize these three factors, and in so far as any one is omitted, and a blanket charge

substituted therefor, injustice will be done, depending on how far the service rendered to a particular station departs from the general average.

To illustrate the bearing of this proposition, Mr. Abbott gives details as to the cost of installation and service. According to previous telephonic policy, the ratio of the number of telephones to population is very low, as is shown in Table II. Consequently, the installation cost per station has been high. In large cities this has varied from $150 to $250 per station. In medium cities, of say 200,000 population or so, from $90 to $125, while even in the smallest towns it is rare to find a cost of less than $50 per station. Of the installation cost from $10 to $25 is required at the sub-station, depending upon the character and difficulty of wiring. From $15 to $50 for the switchboard, varying with the type of board, size of multiple and percentage of trunking, while the wire plant has absorbed the balance; but if by a more liberal policy the use of the telephone could be so stimulated as to raise the population ratio, to say 15 per cent, it would be possible, even in such a city as New York, to install a telephone plant at a cost not to exceed $60 per sub-station, as is shown in Table III.

TABLE III.

Probable installation cost per station of a telephone plant, sufficient to serve 15 per cent of population:

Item.	*Cost.*
Sub-station apparatus	$15.00
Wire plant, subscribers' lines	14.00
Wire plant, trunk lines	7.00
Switchboard apparatus, subscribers' lines	12.00
Switchboard apparatus, trunk lines	6.00
Total	$54.00

Assume now that an installation charge of $15 per year per sub-station were made against each one-party line to cover interest, depreciation and maintenance, $10 per year per station each against two-party line and $8 per year per station against each four-party line, and that a charge of one cent was made for each time the central office was called up and one-half cent for each minute of actual time that the telephone was in use. Large business houses and the best class of residences would take one-party lines. Smaller business houses and medium residences two-party lines, while the bulk of subscribers would use four-party lines; all of these being arranged with selective signals and lock-outs to secure the best quality of service.

Simply to illustrate the effect of this system of tariff, assume one-party lines to average ten calls per day, two-party lines seven and four-party lines three. Under these circumstances, one-party lines must bear a tariff of $75 per year; two-party lines $52 and four-party lines $23. According to this suggestion, the annual cost of maintenance and depreciation on plant would be cared for by the annual flat rate charge, which, for this purpose, is sufficient in a properly installed and maintained plant. The receipts from traffic would average $20 per thousand calls, while the actual expense should not be over $7 per thousand calls. The difference of $13 would be ample to pay reasonable general expenses and dividends. At each sub-station, a meter would be installed, carrying two dials, one showing how many times the exchange is called, and the other the total time expended in the use of the telephone. This meter should be in plain sight of the subscriber, so that he, at any time, could check the readings with his own watch. Such a device could be made and installed at an expense not to exceed $3 per station. Each station would be charged for exactly the service rendered, and it would be optional with all to regulate charges to suit their wishes.

Mr. Abbott adds that while it is impossible to make any one method of charging universal, the main idea should be to produce a rate that will be absolutely just, and be capable of so stimulating telephonic business as to place an instrument in every house. A scheme of this general nature would go far towards smoothing out the existing friction between the operating companies and the public.

Referring to the engineering side of the question, Mr. Abbott says that two very curious tendencies are observable. Among the older companies and the most advanced of the Independents, there is a very strong inclination to design plants with the utmost care and skill, using the widest and best experience for the purpose, and foreseeing the future as far as possible. But with the newer and less experienced of the Independents, there is a most conspicuous absence of design.

Conduit construction has settled into pretty well recognized channels, involving chiefly the use of vitrified clay pipe, particularly the multiple duct forms. Periodically, a new and improved form of duct material appears destined to supersede all others, but the tile men serenely go their way, and their output to-day is larger than ever. The construction of aerial lines is rapidly becoming systemized and proceeding under standard specifications, the tendency of which is to build the lines much more efficiently and much more solidly than in the past, and to restrict the use of open wires to three or four cross arms.

There is a notable tendency to increase the size of cable. Formally 120 pair was standard for underground work and 25 for aerial, but at present 200 pair is becoming almost universal, and even 400 pair has entered the field underground; while aerial cable has grown so that 150 pair is not unknown. For trunk lines and toll work, large conductor, low capacity cables are to the front, even to the extent of using No. 16, No. 14 or even No. 12 wire, with capacity of from .06 to .05 M. F. per mile. In switchboard practice, the common battery automatic signal board is rapidly expelling all other forms and soon will apparently reign supreme, for at present there is not a shadow of rival looming on the telephonic horizon to dispute its supremacy. While switchboards of this type are a vast improvement over those of older construction, Mr. Abbott says they still leave much to be desired, and that the entire telephonic fraternity wait with open arms the coming of the perfect switchboard. There are many who believe that a purely automatic board will offer the desired solution, but during the past decade the progress in this direction, he says, has been almost infinitesimal. A central office seems to be one of those things that needs the human element, and cannot be made purely mechanical. He adds that possibly the recently invented Faller mechanical operator may form at least a partial solution.

As to the sub-station, the transmitter, receiver and magneto have remained in *statu quo* for ten years, save that each manufacturer dresses his apparatus in a newer and possibly more fanciful design. This is strange when it is considered that actual telephonic efficiency is less than two per cent, and that a very slight improvement in this direction would be hailed with delight by all, particularly by those who do much toll work. Part of the difficulty lies in the electrical characteristics of the line, and for this Dr. Pupin's epoch-making discovery is supposed to be a panacea, but as yet results from practical experience therewith have not been reported.

As to the future, Mr. Abbott says that despite the claims for the Hertzian waves, there is nothing at present to suggest any radical discovery in the telephonic field. On the other hand, the art is gradually settling down to that inevitable and comfortable basis wherein sound financial judgment as to the expediency of a telephone plant, skilful engineering in design, the best possible construction, good business management in operation, fairness in the tariff and in the treatment of the subscriber, will be absolutely essential to produce a good balance sheet.

TELEPHONE RATES FROM AN ENGINEER'S VIEW-POINT.

Mr. F. J. Dommerque, in a paper with the above title, introduces the subject by a general discussion of flat-rate and measured telephone service. The matter of rates is then taken up, and after pointing out that the more the subscribers, the higher the rates must necessarily be, he discusses the feasibility of arranging a city service on the principle of village service, thereby giving every subscriber a comparatively low rate without deteriorating the service. A plan is suggested whereby residence, trades and business districts would have separate exchanges with flat rates for calls within a given district and a toll rate for calls to another district. Such an arrangement would tend towards large offices in the center of cities and smaller offices in the residence portions. In the business districts those not employing the telephone frequently could reduce the cost of service by being connected to two-party lines.

This scheme of charging for telephone service would therefore be as follows: (1) For the business portion of cities a flat rate to all busy subscribers, and a reduced flat rate to less busy subscribers using a two-party line. Pay stations, of course, cannot be dispensed with, but should only be used in certain *quasi* public places so as to give transients an opportunity of telephoning without having to intrude upon the regular subscriber. (2) In the residence districts, flat rate for local calls with measured service for trunk calls. Here, also, two-party line service can be used probably to still better advantage than in the business portion and would double the capacity of a small residence district switchboard.

With more than one office in the business district of a very large

city, the flat rate would be different in the various offices and would be in correspondence to the average number of calls originating in the offices. A measured rate for trunk calls in addition to a flat rate for local calls should be made, only outside of the business district where the total number of originating calls is low. This trunk charge would have another beneficial effect, as it would cut the calls into busy offices down to the lowest amount and thus help to keep down the trunk expense in such busy offices, which would not be the case, if the residence district subscriber, who usually is not pressed for time, could make as many trunk calls as he pleased under a flat rate.

Mr. Dommerque points out a fallacy in the comparison of telephone charges with charges for electric light and gas service based upon service actually received. In electric light service as well as in gas service, reservoirs store the energy, i. e., accumulators in the case of electric light supply and gas tanks in the other case, take care of the peak or peaks of the load curve, while in a telephone plant we cannot store the energy developed by the operator, and must build our plant large enough for the highest peak of the load curve and therefore have, for say 22 hours of the day, a plant on our hands that is used at low efficiency. Thus the same switchboard equipment and a line has to be built for each and every subscriber whether he calls once or one hundred times a day. It is, therefore, not more than correct to charge a flat rate, allowing certain modifications as the two-party line rate and regulate the flat rate according to the plant and service required. Size of plant and number of operators being purely a function of the number of calls; the flat rate should be proportional to the number of calls.

There is another incongruity in the comparison. In electric light and gas meters the quantity of energy supplied or the time of duration of supply is measured, so that each customer pays exactly for what he receives. In measuring telephone service, no account is taken of the time or duration of conversation, but the number of calls only is recorded. It is true that for local calls, i. e., for calls between subscribers connected to one and the same switchboard, duration of conversation does not noticeably influence the operating labor and thus would not enter into the question of charge, but for trunk calls, i. e., for calls that have to be transferred from one operator to the other, it is different. For local calls, one and the same subscriber is always connected to one end of his line and different subscribers may be switched onto his line; the subscriber may use his own line as long as he pleases, as nobody else would use it anyway. In the trunk line case, *no* subscriber is permanently connected to the trunk line and therefore subscribers may be switched onto either end of the trunk line whenever the trunk line is free. Thus a trunk line (and toll and long distance lines the same) may be kept "loaded" all the time, and it is clearly visible that the duration of conversation over trunk lines is an important factor and regulates the number of trunk lines, trunk sections, trunk operators and everything pertaining to it. This circumstance is well taken care of in toll and long-distance charges. Therefore, a measured service for trunk calls seems justified and there might be also a time limit to trunk calls, but probably it would involve more labor on the operator to take account of the time than the additional income would warrant; the case of toll and long-distance lines is different, as great capital is invested in such lines, these being very long, while ordinary trunk lines are comparatively short.

As to the subject of rates, many independents made the mistake to start in with too low rates. In order to determine the correct rate that should be charged to assure the operating company a reasonable profit, all items that are involved in the annual expense should be closely calculated. The depreciation factor on the plant should not be taken too low, as there are so many unforeseen incidents such as blizzards menacing pole lines, new inventions making switchboards obsolete, etc., that may deplete the treasury in a short time. The allowance for depreciation should not be below 10 per cent on the switchboard; 15 per cent on open wire pole lines; 4 per cent. on conduits; 12 per cent on cables.

When figuring on the cost of operation, it must be taken into account that not only the salaries of operators working at the board, but also the salaries of chief operators, monitors, night operators, office managers, repair men, matron, janitor and messengers, as well as the salaries of the clerical force directly connected with the operating department, must be taken into consideration. The salaries of the officials of the company, as well as the taxes that have to be paid are to be charged under the heading of fixed charges. A reasonable amount of rent must be charged, and on this point care should be taken not to make the figure too low, as it is often found afterwards that the rent to be paid for the best location of the office is high, because the owner of the property has found out how desirable his property is and charges accordingly.

In estimating upon the cost of the aerial and underground construction, a good many local circumstances have to be taken into consideration, as the formation of the soil, whether same is favorable or unfavorable to the setting of poles, etc. In the case of underground conduits there are obstructions to overcome, the streets in many cities being filled with all kinds of pipes so that it is very hard to lay additional conduit. In the city of Chicago, an amount of $1.20 per linear foot was added to the cost of the underground conduit in a certain street on this account. As far as the maintenance of the plant is concerned, the figures should not be taken too low. Of course, on underground conduits the maintenance means very little, while on aerial lines it may be as high as $25 per subscriber per year.

The discussion was opened by Messrs. John J. Carty, and continued by E. P. Thompson, Henry G. Stott and C. P. Steinmetz. The chief discussion was that of Mr. Carty, who made a long and able address, partly in defence of the Bell regime and policy and partly in relation to the technical issues raised. He disputed the allegation of Mr. Abbott that the Bell management had opposed the publication of technical papers and data bearing on the telephone art, and said that in his own case, how far he should go in giving out information was a matter left entirely to his own judgment. He held that there was a proper amount of reserve in regard to every industry, and that some topics lent themselves more freely than others to treatment in essays and the like. As to telephonic literature, he claimed that the development by Dr. Pupin before the Institute of his theory and practice of "loading coils" for telephone lines ought not to be omitted from that category.

As to improvements in telephone apparatus, Mr. Carty denied Mr. Abbott's idea of a general apathy in the Bell attitude, and took up specific cases. Some apparatus was not changed because it was hard to improve, and the general adoption of Bell standards was evidence enough in various directions. As to bells not alone had the Bell system introduced his own bridging arrangement very largely in the last eight years, but it had again changed this type for another later one for the sake of advance and improvement. Mr. Carty also instanced the almost universal adoption by the Bell system of "common battery" switchboards in cities and the abolition of the magneto set at the subscriber's station.

Mr. Carty also devoted a little time to "analogies" in regard to telephone charges, and quoted a well known expert—probably President Hadley—as admitting that telephone rates were far harder to deal with than railroad rates. He showed that if one wanted to do so, it would be easy to find fault with the inequality of the postal system charging two cents for a letter carried three miles or 3000; or of the street car system charging a man 5 cents for riding ten blocks, but asking no more if it hauled him all the way from Harlem to the Battery. The telephone service was steadily being reduced to a scientific basis, and in that respect could hold its own with any other medium of public service.

In response to requests, President Steinmetz discussed at some length the nature of waves in telephone transmission and the work that Heaviside had suggested and Pupin had done in putting self-induction into the lines so as to leave the wave forms perfect and to improve the quality of the speech transmitted.

TELEPHONY—1902.

In addition to the above papers, Mr. Angus Hibbard read a third paper before the Chicago meeting, entitled, "Telephony—1902," which was largely a discussion of the question of rates. The recent great growth of telephone service Mr. Hibbard ascribes as being largely due to the introduction of the message rate system. Classes of such rates have been made which have been availed of by the public in ever-increasing numbers, extending even so far in some cases to the patron who may use the telephone not more than once a day. As examples of the great growth in telephone service which has followed, it is stated that in Chicago the net growth for the past year in the number of telephones exceeded the total number operated at the beginning of the year 1898; and that in the San Francisco exchange 30,214 telephones were in operation at the close of the year, being 1 for every 11.3 of population. As a result of a study of American practice in this and other respects, the engineers of the British Post Office Department have recommended as the basis of charge the payment for service by the message, and for small users, the payment for service at the time it is rendered, using so-called "slot

machines" for that purpose. They also recommend the use of the relay multiple switchboard and trunk line switching machinery of the type largely used in America.

Mr. Hibbard argued that telephone service is a natural monopoly and that great losses are entailed on a community where there is more than one exchange. An instance is given of one city in which there are two exchanges, and the statement made that if all telephones were connected with one exchange, all the benefits of the present service would be secured and there would be a saving of more than $400,000 per year to the community. Referring to telephone cables, it is stated that ten years ago conservative engineers recommended 50 pairs of wires as the greatest number advisable to be contained in one cable, but that to-day many cables are in use containing 400 pairs. Less than eight years ago electric lamps were first used for signaling purposes on subscribers' lines, and to-day not less than 500,000 such lamps are in use.

Private Branch Telephone Exchange Work on Electric Railways.

The extent to which the use of the private branch telephone exchange is being carried is hardly appreciated by those who do not come into touch with this class of work. As a matter of fact, there are in New York City more private branch telephone operators than there are operators in the regular exchanges. This speaks volumes for the convenience afforded by such a method. Probably one of the most complete systems of private telephonic communication in existence has been established in the Borough of Brooklyn, and the accompanying diagram gives a general idea of the various connections found in this method of bringing together every office, shop, yard and power station of the Brooklyn Heights Railway Company. The private exchange is located at the main office of the railway on Montague Street, and it is here only that special operators are required. A view of this exchange is given in the accompanying half-tone engraving. As will be seen, accommodation is required for two operators, and during the day they are kept busy making local and outside connections. At all times, day and night, there is at least one operator in attendance. A very complete system of bookkeeping has been inaugurated in this department for recording calls and showing the amount of business done.

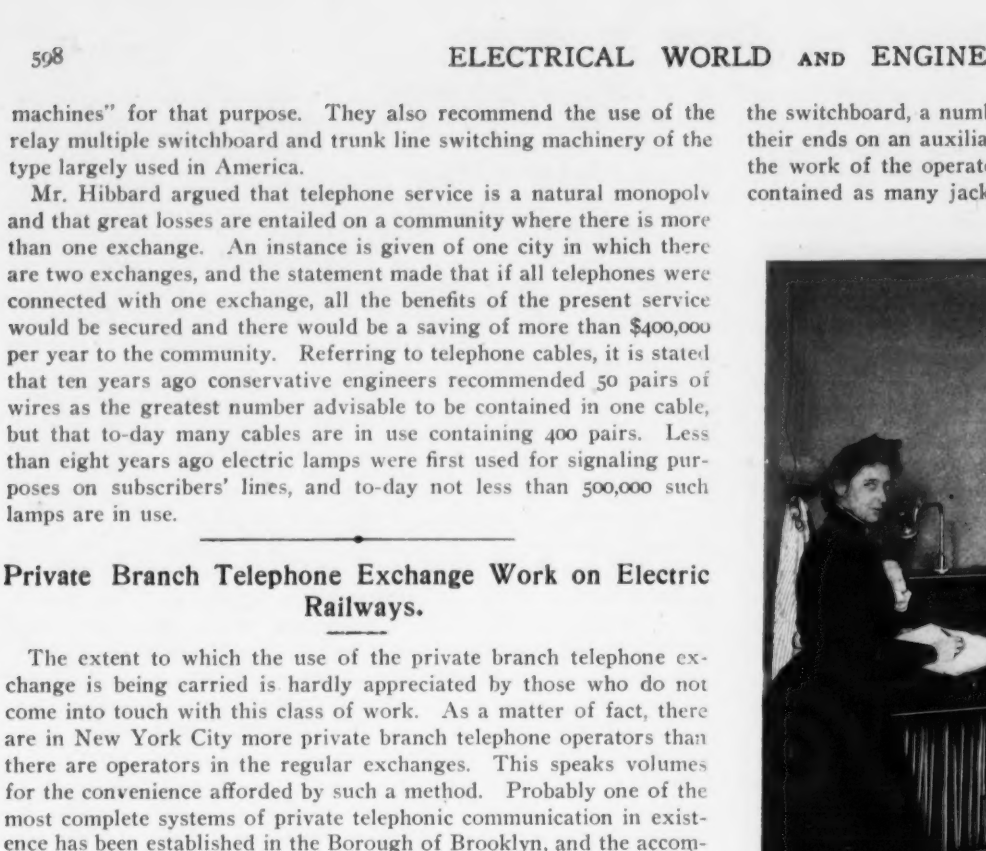


FIG. 1.—DIAGRAM OF BROOKLYN HEIGHTS RAILWAY TELEPHONE SYSTEM.

The private branch exchange has at present 147 extension stations, of which 30 are in the building where it is located and the remainder distributed all over Brooklyn. There are only 83 jacks in the switchboard, a number of the lines having several instruments at their ends on an auxiliary exchange or being used as party lines, but the work of the operator is, of course, practically the same as if it contained as many jacks as there are extension stations, or 147, as

FIG. 2.—PRIVATE EXCHANGE OF BROOKLYN HEIGHTS RAILWAY COMPANY.

above. In general only calls involving the central station, both outgoing and incoming, are recorded, but a count of the local business was courteously made last week for the benefit of this paper. It showed, under ordinary conditions, a total of 900 local calls for a single day. The average outgoing and incoming calls are respectively 450 and 600, showing that the various departments call each other up twice as often as they call outside, and that three-fifths of the calls received by them are of the local type. These calls are, of course, much more numerous during times of trouble, such as fires, snowstorms, breakdowns, etc., but the greatest increase is almost invariably on the local calls. At such times the chief operator goes to the "supervising set" at the left of the switchboard and attends personally to all the trouble calls, many of which have to be taken down on paper and repeated on account of the lines being abnormally busy. The chief operator has complete charge of the bookkeeping of the department as well as a general superintendence of the system, two other operators being constantly employed at the switchboard during the day. Between the hours of 7 and 8 each morning every wire of the exchange is tested and all telephones which do not work properly are reported immediately to the New York & New Jersey Telephone Company, which makes all repairs to lines and instruments. One of the duties of the operators is to give the correct time to the power stations, car houses, etc.. A self-winding clock is placed in the exchange room for this purpose, giving standard time and controlled by the circuits of the Western Union Telegraph Company.

Although the common battery telephone system is in use in Brooklyn the railway company's exchange has not yet been arranged for its use on the private lines. It is still operated, therefore, from bat-

tery cells in the basement of the building. The great length of the private branches would render it difficult to operate the system on the battery now installed at the telephone company's central. A special power trunk is provided to supply the Brooklyn Rapid Transit exchange with current for calling central.

One point of interest to be noted on the diagram, which is reproduced from a drawing recently made for the officers of the company, is the large number of wires running to the New York & New Jersey Telephone Company's central exchange. There are fifteen of these trunks, six being used for outgoing calls and nine for incoming, except in very rare cases when the ordinary balance is materially disturbed. It is very exceptional, for this reason, to find "the line busy" when telephonic communication is desired with the Brooklyn Rapid Transit. Some of the auxiliary exchanges in the outlying districts have as many branches as the ordinary private exchange and the extension stations on these may be used for intercommunication even when the line to Montague Street is busy. There are no regular attendants at these smaller exchanges, as they are placed in offices where there is always sure to be some one present to make the desired connection. Every telephone on the system can be connected to the Brooklyn exchange, and from there to the local city or long distance lines.

The railway company rents its instruments and lines from the telephone company, a certain amount being paid each year for their use. There is no charge for local calls which do not use the trunk lines. Records are made on slips of all outside calls which are afterward summated and compared with the accounts of the telephone company. A complete check is also kept on all "foreign" or extra rate calls, and a daily statement rendered to the various departments. Private calls, where there is an extra charge are paid for by the individual making them.

Some Recent Electric Furnace Products.

By Clinton Paul Townsend.

Although the pulverization of metals in the electric furnace forms the subject of several patents issued in this country and abroad, but little is known of the practical operation of the methods or of the nature or use of the several products obtained.

The general method is simple in the extreme. A metal is heated either by the arc or by the passage of a heavy current through a column of reduced cross section, and is thereby brought to the temperature of volatilization. Vapors so produced are, in most cases, directly combustible in air, burning freely to oxide, or may be subjected to various reagents with corresponding variety in the products; or, finally, the metal may be collected directly in comminuted form in an inert atmosphere. The applications of the method embrace the manufacture of a whole series of pigments, abrasives, refined metals, and miscellaneous reagents.

In 1896, the Société Civile d'Études du Syndicat de l'Acier Gérard, of Paris, patented abroad a method designed primarily for the production of steel from pig iron by a modified Bessemer process, the principal feature of which was the comminution of the metal before subjecting it to a graduated blast of air, the effect being, as in the converter, the oxidation of silicon, sulphur, phosphorous, and carbon, and the conversion of the pig metal into steel. As one method of pulverization, the employment of the arc was suggested, the fused metal falling in a stream between the circuit terminals and collecting after passing through an air blast in the hearth of the furnace.

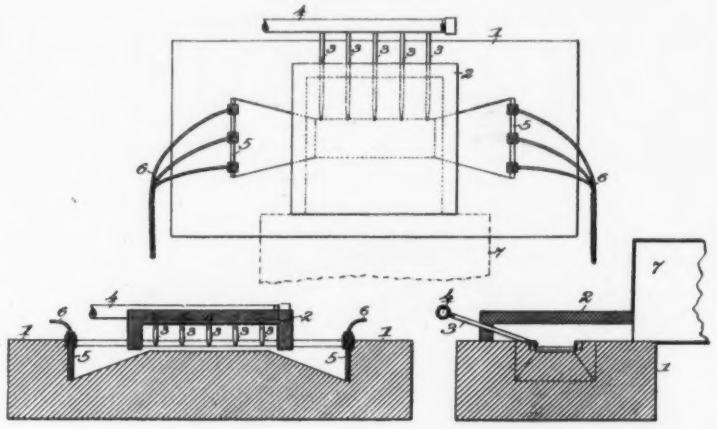
Later, a modified construction was adopted wherein a metal formed a short circuit between water-cooled terminals, and the air blast was projected against its surface at the point of maximum temperature; the vapor was thereby oxidized, and carried over to a collecting chamber forming a part of the furnace.

The substitution of other metals for pig iron suggested at once several modifications of this process, to wit.: the comminution of lead for use in accumulators; the production of litharge by the concurrent oxidation of the lead; the production of zinc as a sublimate, or, in the presence of an air blast, of zinc white; the production of rich mattes of copper, or the pulverization of this metal as a preliminary to the extraction of the contained values; the production of powders of bronze, tin, and aluminum, which enter in many ways into industrial processes; and finally the comminution of chrome—or tungsten—steels, to serve as abrasives.

An analogous procedure for the manufacture of white lead has been patented in this country to Messrs. Bailey, Cox and Hey. In this process the arc is struck from a tubular electrode to the surface of a mass of molten lead. Commingled vapors of water, carbon dioxid, and acetic acid, introduced through the hollow electrode, are presumed to react with the vaporized lead to form commercial white lead; the function of the acetic acid in this process is not clear and its use is probably merely a relic of various prior methods operating at temperatures at which the acid is stable.

Messrs. Bredig and Haber have noted in the *Berichte* a curious phenomenon, which occurs when the arc is struck beneath the surface of the electrolyte, either acid or alkaline, to a lead wire cathode, or when high cathode current densities are used under these conditions: the metal is disintegrated, appearing as a cloud in the solution, and white lead may, it is said, be produced by merely injecting air and carbon dioxid. The method is of course, not a commercial one.

Recently M. Bary, of Paris, patented a furnace for the commercial production of stannic acid. This device was figured and described in these columns Nov. 16, 1901. The molten metal is included as a resistance in the circuit, and the vapors as they escape from an orifice in the furnace cover are ignited by an air blast, and the dioxid collected. The Tin Electro Smelting Company, Limited, of Paris, which controls this patent, is also marketing a series of pulverized metals, presumably made in an analogous manner. These are, an impalpable powder of tin, known in France as Argentine, and capable of giving,



FIGS. 1, 2 AND 3.—LOMAX METHOD OF FORMING OXIDE OF LEAD AND TIN.

by simple rubbing, a burnished foil-like surface to paper: several grades of pulverized aluminum, the finest constituting the base of a new high explosive, and the coarser grades adapted for use in thermite reactions, as, for instance, the reduction of oxide of chromium, etc.; and pulverized lead, employed for the manufacture of minium, of white lead, and particularly for the production of sodium nitrite.

The latest patent of the series, issued March 25, of the current year to Clarence S. Lomax, of Everett, Mass., covers a method of forming oxides of tin and lead; the furnace used is diagrammatically shown in the accompanying figures. The hearth 1 converges both laterally and vertically to a central shallow, horizontal channel of uniform cross section, and in operation is filled to the level indicated with the molten metal. Electrical connections 5, 6, are made with the larger, and therefore cooler terminal pools, while the highly heated central portion is subjected to the air blast from tuyeres 3, 4, the oxides formed being directed by the cover 2 to a suitable collecting chamber 7. This method is distinguished from that of Bary in that the blast plays directly on the surface of the metal instead of upon vapors arising from it; the metal is not permitted to vaporize, and the whole operation takes place at a lower range of temperatures. The method is, in fact, that of Gérard, adjusted and controlled by limiting the action of the air blast to a portion of the surface which is maintained constant and at a uniform temperature.

Concerning the products of this furnace, it is said that pure dioxid of tin may be produced by the action of an air blast heated to 400° C., upon the molten metal at 1200° C.; under the same conditions, a cold air blast forms the mixture of dioxid and monoxid known as putty powder. For the production of oxides of lead, cold air is used.

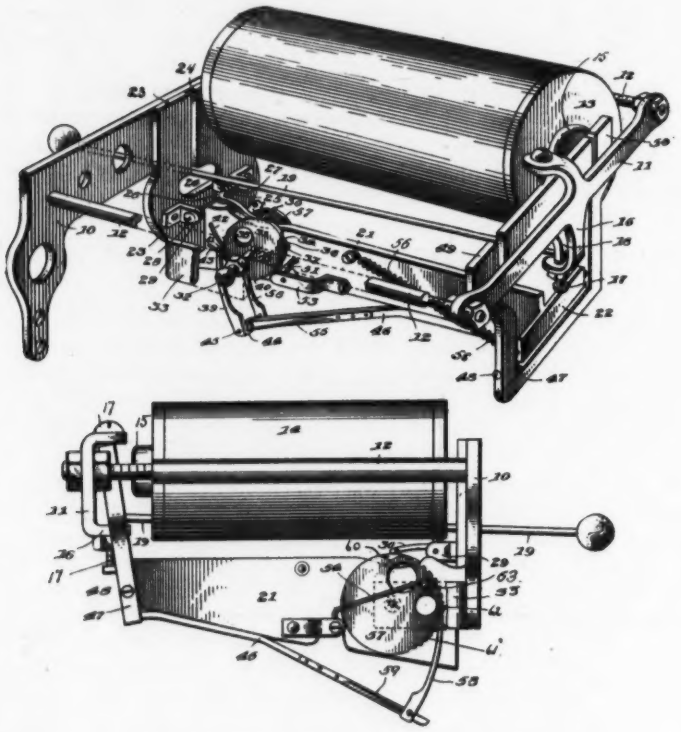
New Telephone Patents.

The issue of March 25, 1902, contains three telephone patents, all bearing more or less on mechanical additions to telephone circuits.

Mr. William D. Watkins, of San Jose, Calif., patents and assigns one-half to John W. Bolster, of the same place, a telephone selecting device, the object of which is so to control the armature of a magneto bell that it will be locked until the proper number of impulses has been sent along the line to free it and enable the bell to be rung. This object is effected by providing the hammer shaft of the bell with a lug, which is normally locked by a tumbler controlled by a disk, which has to be rotated a certain number of steps until the tumbler falls into a notch and so releases the lug.

Fig. 1 gives a fairly clear idea of the locking device, and Fig. 2 of the supplementary disk or restoring mechanism. The clapper 19 is provided with a lug 25 projecting downwardly in the path of the locking tumbler 26. When this tumbler is in the path of the lug the clapper is held from vibration. The rear arm of the tumbler lies upon the periphery of the disk 31, which has a notch 34 to receive the end of the tumbler arm when moved to the proper position. The disk is held normally with the notch out of operative position by being made heavier at one point. The disk is rotated by means of pawl 39, and engaging in ratchet tooth 40, worked by lever 46 attached to the U-shaped armature 47. Thus, if a series of impulses be sent through the magnet the armature will move the disk 31 a sufficient number of steps to carry the notch into position to receive the tumbler arm and so release the lug. The second disk 57 acts to prevent the bell responding to a small number of impulses when being actuated by a larger number of impulses. It has a notch 60 which normally lies below the end of the tumbler arm in which position it is held by the center of the gravity of the disk, being below its axis.

In operation, the first pulsation that moves 31 one step moves also 57, so that its notch is out of position to receive the end of the tumbler, and 57 stays out of such position until the final pulsation, which is continued long enough to permit 57 to return to its normal position. As this final pulsation also brings the notch of 31 into active position the tumbler arm may then drop and allow the tumbler to release the clapper. When the final pulsation is given disk 57, by means of striking upon stop 63 and lever 54, moves the retaining pawl from engagement with disk 31. The rotating pawl, however, holds disk 31 until the circuit is broken, which permits the rotating pawl to release disk 31 and the parts then return to their normal position. This device is an ingenious method of making ordinary magneto bells responsive to selective signals, but it is questionable whether the rather delicate mechanism required would stand the wear and tear of constant use.



FIGS. 1 AND 2.—WATKINS' TELEPHONE SELECTING DEVICE.

Messrs. John Brownrigg and John K. Norstram, of Chicago, patent an automatic telephone system, the object of which is to provide switchboards at the central office which may be actuated automatically by any subscriber, and which are provided with a common source of power for the restoration of the parts to their normal position after the completion of the connection. The specification refers to various other applications for patents on parts of the system, which are not yet issued. This patent has particular reference to the arrangement in a complete system of a source of power for effecting the restoration of the movable contact to its normal position; the power employed may be vacuum, compressed air, hydraulic or other mechanical pressure. Referring to the diagrams of Figs. 3, *A*, *A*1, etc, designate a series of switchboards, one for each subscriber to the system. *B* is the movable carrier or contact maker. *C* is a rocking-shaft through which long-feed and short-feed movements are imparted to *B*. *D* is the magnet for rocking the shaft for long-feed movements, and *E* the magnet for imparting the short-feed or step-by-step movements to *C*, by means of the ratchet *F*. *G* is a cylinder carrying the piston or counter weight controlling *B* through cord *H*. J is the valve chest for controlling the supply of pressure to cylinder *G*; and *K* the magnet which controls the valve.

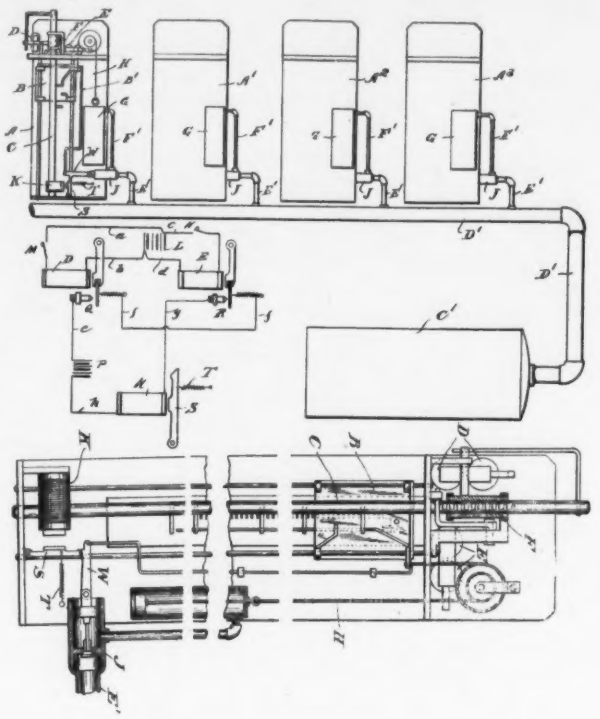


FIG. 3.—AUTOMATIC TELEPHONE SYSTEM.

Referring to the diagram of electrical circuits, when the circuit-closer *M* is closed magnet *D* is energized by battery *L*, and by making and breaking at *M* the carrier *B* is moved by the rocking-shaft *C*. By circuit closer *N* magnet *E* is energized by battery *L*, effecting the short-feed or step-by-step movements to *B*. Magnet *K* may be controlled in any suitable manner. As shown, it is operated when *M* and *N* are closed simultaneously. Magnet *K*, by means of lever *S* controls the movement of the valve supplying pressure for restoring the movable carrier to its normal position, *S* working against the hook-latch *W* connected to the valve. When *B* is restored to its normal position *W* is lifted from engagement with *S* by means of the rod *B'*. *C* illustrates a reservoir for supplying the pressure to cylinders *G*. This system is apparently neither more nor less complicated than most of the automatic exchanges that have been produced, but without the specifications covering other parts of the system referred to it cannot well be judged whether the operation of the selecting mechanism would answer the requirements of an automatic switch.

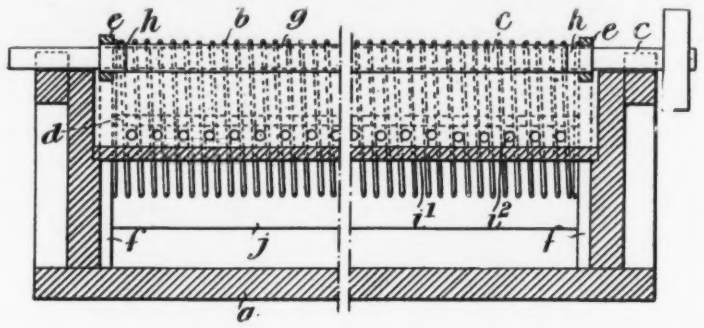
Mr. E. E. Salisbury, of Chicago, patents an automatic gravity signalphone. The invention is described as embodying improvements in automatic gravity signalphones. This being the first time one has heard of a "signalphone" it is all the greater novelty to know that such an appliance has been improved on. The mechanism covered by the patent is a device through which, by means of a contact making

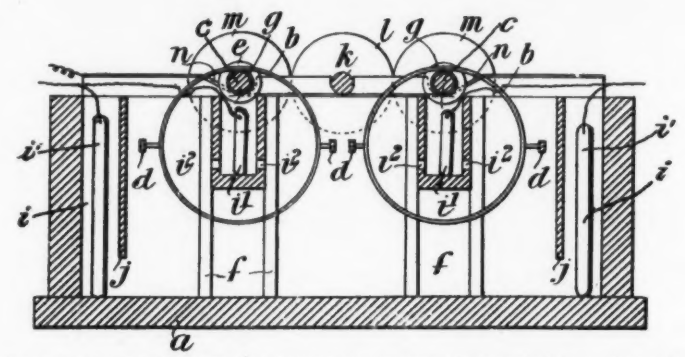
segment, whose movements are controlled by those of the switch hook, a series of impulses is sent along the line whenever the receiver is taken off the hook. A detailed description of this device is scarcely necessary, as it has little place in telephony proper, it being merely a call-box with a telephone attachment.

Electro-Deposited Wire Bars.

Under date of March 25, Mr. Richard D. Sanders, of Blackheath, England, patents the device herewith illustrated, for the manufacture of compound wire bars by electrodeposition; the term compound, as used in this connection, indicates a heavy electrodeposit of metal, usually copper, upon a drawn wire base.

The wire *b*, which forms the cathode and base for the deposit, is loosely wound and hung upon the driven shaft *c*, mounted on the depositing vat *a*, the convolutions of the wire being kept apart by spacing pins *d*. To aid in giving the wire a permanent set to keep the convolutions spaced, it is sometimes flattened before winding. By rotation of the shaft, the entire coil is revolved partly within and partly above the bath, and as it revolves, it receives the electrodeposit from two series of anodes *i'*, respectively within and without the coil: each set of anodes is placed in a compartment separated from the





FIGS. 1 AND 2.—SANDERS' METHOD OF ELECTRODEPOSITION OF WIRE BARS.

depositing chamber, the external anodes by a depending partial partition *j*, and the internal series by a perforated receptacle *i*.

This general disposition is not new. Mr. Sanders' specific improvements relate to means for overcoming two defects in the older devices, such defects being first, the tendency of the coil to crowd to one or the other end of the bath, according to the direction of its revolution, and second, the roughness of the electrodeposit, due to a sparking contact with the shaft. Both the difficulties are overcome by the construction of the shaft; as indicated, the shaft itself is enveloped by a tubular non-conductor *g*, which may be a glass tube, at the ends of which are the metallic ferrules *h*, through which cathode connection to the coil is made. Outside of these ferrules are placed insulating collars *e*, forming end bearings to prevent progression of the coil during its rotation. These latter may be supplemented by vertical strips or rolls *f*, of glass, which take the thrust of the submerged portion of the coil.

As indicated in Fig. 2, a number of coils are mounted in a single vat, and driven by a series of friction wheels *m, l, m*, resting in inclined bearings *n*.

Pacific Cable.

The laying of the Australian-New Zealand section of the Pacific Cable has been completed.

Independent Telephony in Wisconsin.

The independent telephone movement in Wisconsin is one of the most important and rapidly growing enterprises in which Wisconsin capital has ever become interested. By the reports of the President and Secretary of the Independent Telephone Association, which held a meeting in Milwaukee recently, it was shown that the association has a membership of 185 companies, representing a total investment of about $3,000,000. These companies have 200 exchanges, 850 toll stations and 8000 miles of toll line. All this work has been done within six years, and the independent companies are now doing the bulk of the telephone business throughout the State. The business has developed so rapidly that the independent interests began to realize that there should be some kind of organization among them to encourage the work and co-operate in some general plan for establishing connections between the local companies. It was to make this plan an accomplished fact that the Independent Telephone Association of Wisconsin was organized, and it was to consummate the purpose of the organization that the convention selected a committee to take up the matter of long-distance construction. The plan is to connect all the lines in the States and have trunk lines running through the State to the principal commercial centres. Something in this line has already been accomplished. A six-wire copper trunk line connects West Superior and Duluth with Minneapolis and St. Paul. A similar line has been extended from St. Paul to Eau Claire and to La Crosse, and it is intended to extend this trunk line across Wisconsin to Milwaukee. The Interstate Telephone & Telegraph Company, operating in northern Illinois, has completed arrangements for connecting with the independent lines of Wisconsin at Beloit. This will give Wisconsin people communication with Illinois cities, and eventually with Chicago.

Last year the Wisconsin independent companies expended over $500,000 on construction work and gained over 6000 new subscribers.

The Milwaukee *Free Press* has prepared a map of the State showing the vast extent of the independent telephone service. The lower two-thirds of the State is very closely covered with the network of lines, but Milwaukee stands apart from the rest of the State without independent service. In fact the southeastern corner of the State presents a blank spot that tells a significant story to telephone men. Strong endeavor is being made in Milwaukee, however, to secure an independent franchise, and the matter will soon be settled one way or the other.

Current American Exports and Imports.

The manufacturers of the country are now importing more than a million dollars' worth of material for their workshops every day in the year, and are exporting more than a million dollars' worth of their finished product each day. The imports of manufacturers' materials in the eight months ending with February, 1902, were, according to a statement just issued by the Treasury Bureau of Statistics, $270,202,774, and the exports of finished manufactures during the same period were $257,907,430. Thus in 243 days of the fiscal year, manufacturers have imported 270 million dollars' worth of material and exported 257 million dollars' worth of their finished product, averaging more than $1,000,000 of both imports and exports for every day of the fiscal year up to the beginning of the present month. The importation of manufacturers' materials has been greater in the eight months just ended than in the corresponding period of any preceding year.

On the export side of the account manufacturers are showing an improved record. The Bureau of Statistics reports of exports of manufactures during both January and February show a decided increase over the corresponding months of 1901, the gain in the two months in question being more than three million dollars over the same months of the preceding year. The exports of manufactures in the 28 days of February were $31,740,842, against $30,302,592 in February, 1901. In practically all articles except iron and steel there has been a complete recovery from the temporary check in exports of manufactures noted a few months ago. Copper exports, for instance, in February of this year were $4,210,861, against $3,155,774 in February, 1901; though for the eight months the total still stands 8½ millions below that of the same period of the preceding fiscal year. Iron and steel exports show a marked improvement, the total for the

month of February being $7,358,296, against $7,959,218 in February, 1901, and $8,549,157 in February, 1900. For the eight months ending with February the exports of iron and steel manufactures are $64,668,424, against $81,575,685 in the corresponding months of the preceding year.

Chicago Electrical Association Endorses Metric System.

At the meeting of the Chicago Electrical Association, March 7, it was voted to appoint a committee to express to the proper Congressional authoritiles the endorsement by the Association of any action which would tend to a general use of the metric system. In compliance with this action the committee, consisting of Messrs. J. R. Cravath, W. B. Hale and H. M. Wheeler, transmitted to the House Committee on Coinage, Weights and Measures, through Prof. S. W. Stratton, director of the National Bureau of Standards, the following resolution:

"Whereas, the Chicago Electrical Association is informed that your committee is considering the advisability of adopting the metric system for use in the United States, the Chicago Electrical Association, representing largely the electrical interests of Chicago, most heartily endorses any action tending to the general use of the metric system and assures your committee of its cordial support."

Institute Nominations and Elections.

At the meeting of the board of directors of the American Institute of Electrical Engineers on March 28 the following nominations were made for the offices becoming vacant on May 20, in compliance with the constitution: For president, Charles F. Scott, of Pittsburg; for vice-presidents, C. O. Mailloux, Bion J. Arnold, Schuyler S. Wheeler; for managers, Townsend Wolcott, Gano S. Dunn, E. H. Mullin, Charles A. Terry; for treasurer, George A. Hamilton; for secretary, Ralph W. Pope.

The following list of Associates were elected: Edwin David Bevenue-Miller, electrician, Natal Government Railways, Durban, Natal, South Africa; Hugh Auchincloss Brown, general utility engineer, Crocker-Wheeler Company, Ampere, N. J.; Dana Ripley Bullen, salesman, General Electric Company, Boston; Frank Vail Burton, office salesman, Western Electric Company, New York City; Eugene B. Clark, chief electrician, So. Works, Illinois Steel Co., Chicago, Ill.; Frank C. Cosby, salesman, Westinghouse Electric & Manufacturing Company, New York City; James Edward Davidson, superintendent, Port Huron Light & Power Company, Port Huron, Mich.; William Amzi Dick, designing electrical engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Percival Elliott Fansler, post-graduate student, Purdue University, Lafayette, Ind.; Frederick Perry Fish, president, American Telephone & Telegraph Company, Boston; Frederick Jackson Folk, chief electrician, New York & Queens Electric Light & Power Company, Brooklyn, N. Y.; Oliver Remick Grant, student, Columbia University, New York City; Elwood Grissinger, engineer, the Cataract Power & Conduit Company, Buffalo, N. Y.; Clarence Mortimer Hall, teacher of physics and electricity, Manual Training School, Washington, D. C.; Charles Hodge, salesman, Westinghouse Electric & Manufacturing Company, New York City; Charles William Hogan, photometric expert, Columbia Incandescent Lamp Company, St. Louis, Mo.; Woolsey McAlpine Johnson, electro-metallurgist, Oxford Copper Company, New Brighton, S. I.; Percy Henry Knight, district engineer, Westinghouse Electric & Manufacturing Company, San Francisco, Calif.; Alphonsus Joseph Miller, laboratory assistant, Western Electric Company, New York City; Edwin J. Murphy, assistant engineer, General Electric Company, Lynn, Mass.; Addams Stratton McAllister, assistant in physics, Cornell University, Ithaca, N. Y.; William Henry McGrath, electrical engineer, with Stone & Webster, Boston; Ellis Laurimore Phillips, engineer, Westinghouse, Church, Kerr & Company, New York City; Alfred Lawrence Pierce, superintendent, general manager and electrical engineer, Borough Electric Works, Wallingford, Conn.; Claiborne Pirtle, sales agent for North Carolina General Electric Company, Greensboro, N. C.; Albert Augustus Radtke, instructor of electrical engineering and physics, Rhode Island College of Agriculture and Mechanic Arts, Kingston, R. I.; Louis Embree Reynolds, chief electrician, Independent Light & Power Company, San Francisco, Calif.; Walter S. Rugg, engineer, Westinghouse Electric & Manufacturing Company, New York City; Charles E. Scribner, engineer, Western Electric Company, Chicago, Ill.; Edson Oliver Sessions, construction engineer, General Electric Company, Toledo, Ohio; Edgar F. Sherwood, superintendent of traffic, New York Telephone Company; William Nelson Smith, electrical engineer, Westinghouse, Church, Kerr & Company, New York City; Harry B. Spencer, clerk in draughting department, General Electric Company, Lynn, Mass.; Linden G. White, superintendent electrical department, Columbus Edison Electric Light Company, Columbus, Ohio.

The Telephone in Gas Works.

At the annual meeting of the Ohio Gas Light Association, held last month, Mr. L. W. Wells brought before the members the following suggestion as to practice involving the use of the telephone in gas work, in connection with a steam whistle. He said:

Usually at a gas works, especially in or near the retort house, there is much noise, and a call from the ordinary telephone bell cannot be heard at times by the workmen, and in consequence much time

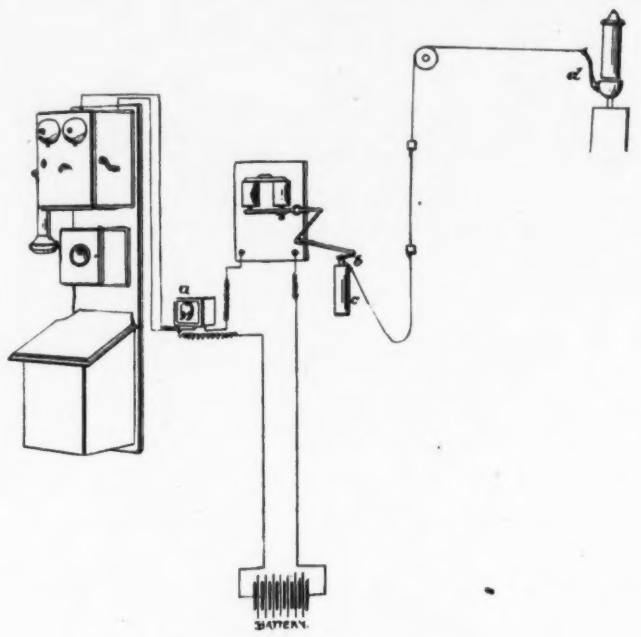


DIAGRAM OF CONNECTIONS.

is lost at the uptown office in communicating with the works. The device illustrated in the drawing in connection with the telephone is the result of an effort to shorten the time in getting someone to the telephone. When a call is made from the central station, the drop *A* falls, releasing the trip on which the weight is hung at *B*, causing the weight *C* to fall, which opens the valve at *D*, thus blowing the steam whistle until the telephone is answered; at the same time the device is readjusted, ready for the next call by the party answering. No battery power whatever is used, only when the drop *A* is down.

Telephones on Electric Street Cars.

The daily papers have recently published accounts of tests made in Grand Rapids, Mich., by Benson Bidwell and his son, Chas. F. Bidwell, of an electric street car telephone. Parallel with the trolley wire and about 6 in. from it on both sides, are strung copper telephone wires. A double trolley maintains connection between the overhead wires and the telephone on the car, and at a point along the line is a private exchange through which connection may be made on the cars with the local exchange of the Citizens' Telephone Company. The operator at the sub-exchange can ring up the different cars along the line by the use of a code of long and short signals. It is therefore possible to reach any car in any part of the city, and *vice versa*, any subscriber of the Citizens' Company may be reached from any car. It is claimed that this system works satisfactorily whether the car is in motion or not, and that inductive effects, due to the proximity of the trolley line, are eliminated by the method of running the telephone wires equidistant and parallel to the trolley wire.

Extraordinary Development at the "Soo."

Without question one of the most active scenes of engineering development at the present time in the United States is the "Soo" district, at the point on St. Mary's River where Lake Superior empties into Lake Huron, and where two large industrial towns on the American and Canadian sides have already sprung up. At this point the river has a fall of about 19 feet at the Rapids in a distance of 3000 feet, developing at least 175,000 horse power. Part of this energy hitherto wasted has already been utilized on the Canadian side, and at the present moment two other kindred enterprises are being pushed. While the development will be in sharp contrast to that at Niagara, owing to the slight head of water at the "Soo" as compared with an average of about 200 feet at the great cataract, the two enterprises compare in magnitude and each presents unique features. Data was recently given in these columns as to the new work at Niagara on the Canadian side, for which three of the largest generators in the world are being built. A contrast is presented by the plans for the "Soo," where for the new work now to be carried out, the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has been awarded a contract for no fewer than 40 generators, etc., the impulse wheels to drive which are already in place. The building in which these machines will be installed is itself over a quarter of a mile long and three stories in height, and the power canal which will divert water from the Rapids to the wheels, has also been dug and finished, 210 feet wide, 20 feet deep and three miles long. This development is on the American side of Sault Ste. Marie.

The amount of power to be developed will, it is stated, approximate 100,000 horse power, and this extraordinary plant will unquestionably be by far the largest hydro-electric equipment under one roof in the world. The current will be utilized by the Clergue syndicate, which is backed mainly by Philadelphia capital, for the rolling mills, pulp mills, electro-chemical works and other industries of the Consolidated Lake Superior Company, and concerns of a similar character, while it is believed that a large part of the current will also be transmitted to Canada. The electrical contract is now being carried out and the apparatus will be installed forthwith. It is curious to think that the same water thus used so much higher up on the chain of lakes should again yield its energy at Niagara. The current generated will be three-phase, 30 cycles.

CURRENT NEWS AND NOTES.

PROMPT MEDICAL SERVICE.—By the Kaiser's desire, fully fitted up ambulance trains have been placed at seventy-five German railway stations, and telephonic communication has been made with local doctors, so that any accident can be immediately dealt with.

INSTITUTE'S ANNUAL CONVENTION.—Secretary Pope announces a slight change in the date of the annual convention of the American Institute of Electrical Engineers, at Great Barrington, Mass. The convention will begin on Wednesday, June 18, instead of June 17, as originally planned, and will continue June 19 and 20, and probably the 21st.

WIRELESS TELEGRAPH CONFERENCE.—A cable dispatch of March 29 says: "Prof. Slaby's recent proposal for an international conference to regulate wireless telegraphy already is engaging the attention of Germany, the authorities of which country are now drafting a circular note to be presented to the United States, Great Britain and France, proposing a congress for the purpose of agreeing upon means to prevent a monopoly of wireless telegraphy on the high seas."

TO PENSION TELEGRAPHERS.—A meeting of telegraphers employed by the Western Union and Postal Telegraph companies was held recently in New York City to consider a pension fund. The meeting was the outcome of a letter written by Andrew Carnegie, once a telegrapher himself, to W. C. Connolly, jr., of the Telegraphers' Association, Pittsburg, in which Mr. Carnegie advises the telegraphers to start a pension fund for old or invalid telegraphers. The meeting voted in favor of the idea.

BALTIMORE & OHIO THIRD RAIL.—The Baltimore & Ohio belt line in Baltimore, between Camden station and Waverly, has been equipped on the third-rail system. The old overhead equipment will be removed as soon as all the electric locomotives have been altered to suit the new conditions. At Camden and Mount Royal stations the third-rail is automatically disconnected from the source of electric supply, when it is not in use by trains.

POSTAL WIRELESS TELEGRAPHY.—A special from Washington of March 26 says: "Senator Mason to-day gave notice of an amendment he will offer to the Post Office Appropriation bill, appropriating $150,000 to connect the Post Offices at Washington, Baltimore, Wilmington, Philadelphia, New York, Albany, Buffalo, Cleveland, Detroit, Toledo, and Chicago by a line of wireless telegraphy or wireless telephony." Senator Clay appears to have offered a similar amendment for $150,000 for wireless telegraph experiments.

ENGLISH ELECTRICAL UNDERTAKINGS.—It would appear that at present there are in Great Britain upwards of 1500 electrical undertakings owned by companies or municipalities. Their aggregate capital issued in shares, debentures, loans, etc., since 1896, is detailed below. It will be observed from the following that, regardless of reports of depression in England, the increase of capital last year exceeded all previous ones: 1896, £61,109,525; 1897, £69,209,478; 1898, £84,742,020; 1899-1900, £105,977,719; 1900-1901, £123,636,600; 1901-1902, £165,807,474.

GERMANY-CHINA CABLING.—The German post authorities have concluded an agreement with the German & Marine Telegraph Company, the Indo-European Telegraph Company, and other cable companies concerned in the transmission charges between Germany and China. The new charge, which came into force March 15, amounts to 47 cents per word, as compared with $1.43 hitherto. The only condition is that the telegram be written either in German or English. The telegram will be dispatched to all parts of China without delay in transmission or increase in tariff.

RAILROAD WIRES UNDERGROUND.—With regard to the reports that the Pennsylvania Railroad will put its wires underground as a result of the severe damage inflicted this winter on its overhead wires, Mr. C. M. Sheaffer, superintendent of telegraphs of the company writes us as follows: As regards the statements in the newspapers of the intention of this railroad to put in wires underground between Jersey City and Philadelphia, I would say that no such decision has been made. The question has been discussed, as in fact it has been for several years past whenever we have had any similar trouble like that due to the storm of a month ago, but the excessive cost of any such installation has always prohibited its getting any further than discussion. In this particular instance we may do something in the way of putting some of our wires on our most congested lines underground for short distances, but I doubt very much if anything like the installation of a conduit for so long a distance as from Jersey City to Philadelphia will be done.

TELEPHONE SERVICE ON THE OVERLAND LIMITED.—It is announced that the overland limited trains on the Chicago & Northwestern Railway, which give the fast service between Chicago and San Francisco over the Northwestern, Union Pacific and Southern Pacific roads, will be provided with telephones for the use of passengers while the trains are standing in the depots at Chicago, Omaha and San Francisco. So many of the travelers on the overland limited are business men whose time is valuable, it is argued that a few minutes' use of the telephone before leaving the cities named would be acceptable. A special wire from the train shed to the main exchange offices will be run and particular attention will be paid to giving calls over this wire quick attention. It is also intended to give particular attention to this service by getting connections that happen to be busy so that the service will be of the utmost advantage. It is anticipated that the service will not be used much for long-distance telephoning, but rather for talking in the passenger's home city immediately before leaving. Besides aiding in the transaction of important business en route that otherwise might have to be done by telegraphing, it is expected that the telephone will prove valuable to passengers who forget articles.

GERMANS BUYING CABLES.—A cable despatch from Berlin of March 25 says: The German Atlantic Cable Company has arranged to buy the Emden-Vigo line of the German Sea Telegraph Company. The shares of this latter company are largely held in London, and partly by the Eastern Telegraph Company, Limited.

HIGH VOLTAGES IN THE CENTRAL STATES.—The Union Traction Company of Indiana, in the extensions of its large electric interurban railway network around Anderson, Ind., will employ 32,000-volt transmission lines for distributing electrical energy. The Economy Electric Light & Power Company, of Joliet, Ill., on its 35-mile transmission for operating the Bridgeport pumping station in Chicago will employ a similar voltage.

WIRELESS TELEGRAPHY.—An item from Washington states that there have been fifty-seven patents granted by the Patent Office here on wireless telegraph instruments and their parts, since the first one granted to A. E. Dolbear, Oct. 5, 1886. Thomas A. Edison was the third patentee of this class, and has one patent granted Dec. 3, 1901. G. Marconi followed in July, 1897, and has taken out a total of eleven patents, the last one being dated June 11, 1901. Nicola Tesla has seven, following Marconi closely.

REGULATION IN MASSACHUSETTS.—Last week Mr. Albert E. Pillsburg, for the Associated Gas Companies, and E. W. Burdett, for the Massachusetts Electric Lighting Association, appeared before the legislative committee on taxation in opposition to a bill requiring associations and corporations supplying water, steam heat, light, power, gas, electric light, telegraph and telephone service to be licensed and to pay 1 per cent of their gross receipts as a tax and an additional tax of ½ of 1 per cent on any excess of annual dividends over 6 per cent. The only person who advocated the bill was its author, Representative Davis, of Salem.

RÖNTGEN RAYS IN MEDICINE.—At a recent meeting of the Harvard Medical Society of New York City, Dr. W. J. Morton read a paper on the treatment of malignant growths by Röntgen rays. A report of several cases thus treated was given, and Dr. Morton summed up as follows as to the effects of the treatment: 1. Relief from excruciating pain and constant suffering. 2. Reduction in the size of the new growth. 3. Establishment of the process of repair. 4. Removal of odor, if present. 5. Cessation of the discharge. 6. Softening and disappearance of lymphatic nodes. 7. Disappearance even of lymphatic enlargements. 8. Removal of the cachetic color and appearance of the skin. 9. Improvement in the general health. 10. Cure, up to date, of a certain number of malignant growths. A cablegram last week reported that Dr. Addyman, in a lecture delivered that week in London, said he had cured a bad case of cancer by the action of Röntgen rays.

HOTEL FACILITIES.—At the new Hotel Astor, on Long Acre Square, New York City, a novel device has been perfected by the proprietor, Mr. Muschenheim for removing the soiled china, linen, etc., from the dining rooms noiselessly and automatically, whereby the waiters do not have to leave the room. Wherever convenient, in each dining room is placed an electric conveyer, which is an endless chain of shelves, moving very slowly and noiselessly. The waiter simply steps to the nearest conveyer and leaves his dishes on the shelf passing at the time. The conveyer carries the dishes directly to the cleansing room. It is expected that this device will enable the waiters to spend 20 per cent more time in the dining room, besides aiding them to get the dishes out of sight immediately, thus doing away with one of the most objectionable features in restaurants. The cost of the hotel, including the ground and the furnishings, will be about $5,000,000. It will have an elaborate electrical plant.

WIRELESS TELEGRAPHY IN ALASKA.—Capt. Morse, chief signal officer of the Department of California, has received orders from the War Department to open negotiations for the installation of a system of wireless telegraphy between army stations in Alaska. There are four routes mentioned. Route "A" is to be between Fort Davis, at Nome City, and some point on Stuart Island, 90 miles distant. Route "B" is the preferable alternative of route "A," and is to extend from Davis to Fort St. Michael on St. Michael's Island, approximately 108 miles distant. Route "C" is to extend from Rampart to Winter Hours, on Tanana River, or some other convenient and suitable place near the mouth of Delta River, 136 miles distant. Route "D," the preferable alternative of route "C," is to extend from Fort Gibbon to some point on the Tanana, which is 165 miles distant. The station at the latter place must be at or near the mouth of Delta River or at Bates Rapids, and must be at some point accessible to boats.

ATLANTIC CABLE RATES.—Representive Corliss, of Michigan was given a hearing before the House Committee on Judiciary last week on his resolutions directing the Attorney-General to institue proceedings against the Commercial Cable Company for alleged combination with other companies. Mr. Corliss declared that there had been a deliberate violation of the laws against combination, and that the effect was to advance the cost of cable messages on the Atlantic 12½ cents word. He said the matter had not been brought to the attention of the Attorney-General so far as he knew. Mr. Littlefield made the point that if this was the case the Attorney-General could not be remiss in not acting on it, and Congress was not warranted in giving him directions. Considerable sharp sparring was indulged in as to the amount of evidence Mr. Corliss could produce, after which the committee went into executive session and unanimously reported against the resolution on the ground that Mr. Corliss had not presented a case calling for the action proposed.

LONDON TO PARIS.—A cable dispatch from Paris of March 30 says: "From London to Paris in five hours" may be realized within two years, thanks to a syndicate of Americans whose representatives are now here consulting daily with the authorities of the French Northern Railway. The Northern Railway, whose Calais branch boasts of having the fastest trains in the world, has been trying for years to stir up the two English London-to-Dover lines to shorten the time of the trip. The English argument always has been: "We hold the shortest route, anyhow; why go to the expense of this quickening of the service." The American syndicate mentioned has secured the support of powerful English politicians, and at the next session of the British Parliament a bill will be introduced authorizing a new electric line from London to Dover. The promoters of this enterprise promise to cover the distance in forty-five minutes. The estimated cost of the new road is $25,000,000, on which amount the enormous traffic expected will pay 20 per cent, it is calculated, from the first.

INDUCTION MOTOR AS A GENERATOR.—It is well known that an induction motor can be run as a generator if it be supplied with alternating impulses from an external source. In a patent issued March 25 to B. G. Lamme a method is described whereby an induction machine may be operated in connection with a synchronous motor. The synchronous motor is connected with the circuit to be supplied by the induction generator; when the latter is to be started up, the synchronous motor is first speeded up and run as a generator a sufficient length of time to effect the building up of the field of the induction generator. The power applied to the shaft of the motor may then be discontinued, or the latter run as a motor, when its counter e. m. f. will afford the exciting impulses necessary for the induction generator. During the time that the synchronous motor is run as a generator it will fix the alternations of the system; but when it is run as a motor the alternations of the system will depend upon the speed of rotation, the number of poles and the slip of the induction generator.

TELEPHONY IN SWEDEN.—With regard to the use of the telephone in Sweden, an article in the London *Pall Mall Gazette* says: "Almost everybody in Sweden, and particularly in the City of Stockholm, turns naturally to the telephone, and if one is away from home and suddenly recalled one naturally telephones home to see whether the servants are in or out. The apparatus used is very simple, and the ear and mouth pieces are so connected, and the cord is so long, that you can sit comfortably in your chair and talk. In the house in which the British chaplain at Stockholm resides (a block of ten flats) there are no fewer than ten Allmänna and four Riks telephones installed. It is rumored in Stockholm that an amalgamation of the Allmänna and Riks (Government) telephone is contemplated in the near future. On the Stockholm Bourse the Allmänna shares of 100 kroner are now quoted at 525 kroner. The number of Allmänna telephones in use in Stockholm is at present over 23,000, and outside the city about 4500; and that the instrument is found of increasing value will be seen from the fact that in 1900 there was an increase of 2785 instruments."

THE LONDON CENSUS just taken shows an increase of 16.6 per cent in the number engaged in electrical work in London.

CANADIAN NIAGARA POWER.—On March 24 the first sod on the work of the Ontario Power Company was turned in the Queen Victoria Park at Niagara Falls, Ont. Water will be conveyed in an open canal and conduits to the Horseshoe Falls, at which point it will descend to the power house at the base of the cliff. The initial development will be 125,000 horse power.

TEST OF RAILWAY SYSTEM.—Forty students from the electrical and mechanical classes of Purdue University, Lafayette, Ind., are to conduct an efficiency test at the Anderson power station of the Union Traction Company, of Indiana. The test will be conducted under the direction of A. S. Richey, electrical engineer of the Union Traction Company, and Professor W. E. Goldsborough, professor of electrical engineering at Purdue. The tests will be very complete, and will begin with the coal and extend to the delivery of power at the car axles along the entire system, which embraces 160 miles of track.

TWO-SPEED ALTERNATING CURRENT MOTOR.—In a patent issued March 25 to Benjamin G. Lamme, Pittsburg, Pa., on an application filed July 14, 1900, a two-speed alternating-current fan motor is described. The laminated stator has at considerable intervals two pairs of slots—there being four sets of such slots in the case of a 4-pole motor. The inner slots contain one winding in series and the outer slots another winding in series. The rotor is of the usual squirrel-cage type. For maximum speed the coils are so energized as to produce four poles alternating with each other as is usual. By manipulating a switch the coils are so connected as to cause all four of the poles to have the same sign, in which case consequent poles are produced in the intervening space; the motor then corresponds to an 8-pole motor and its speed is halved.

CAMPAIGN AGAINST THE WORD "HELLO."—The *Chicago Tribune* has been moved to the following facetious remarks about the effort to oust the "hello" from telephonic conversation in one of Chicago's aristocratic suburbs: "It is well that Evanston, which is to Chicago as Boston is to America, has plenty of leisure. Otherwise the campaign which the north shore advance agents of refinement have instituted in Cook County against the telephone 'hello' would not have succeeded, as it is authentically reported to have done. No Evanston good society people any longer say hello over the telephone (and they never did say it anywhere else), because it is a vulgar word, as one of them informs an inquisitive world. But for the present, at least, when Evanston is using its long-distance wires to Chicago, it would better stick to the old style for talk like this: 'Good afternoon, good afternoon, Central, I want Stock-Yards. Good afternoon, good afternoon. Good afternoon, is this Stock-Yards? Good afternoon, Stock Yards, good afternoon,' would be apt to evoke not the morally innocuous, though vulgar, response of commerce, but the same syllables reversed, which so arranged are not merely vulgar but also sinful."

UNDERGROUND ROADS IN PARIS.—A special cable dispatch of March 29 to the *New York Tribune* says: The Parisians are so much pleased with the electric metropolitan railway scheme that the municipal authorities have arranged for the gigantic development and extension of the system. Six new lines were planned some time ago, on which excavation and building are already proceeding. It is now proposed to construct seven more underground electric railways, and a concession has also been granted for a private line, which is to pass in the form of a parabola across Paris from north to south, thus making in all fourteen new metropolitan electric lines. Paris, which has the advantage of being a round city, and not an oblong one like New York, will thus be traversed by numbers of electric routes in all directions and will present the appearance of a skilfully prepared grape-fruit, with fibres and cuttings radiating from the center and intersecting with other fibres forming concentric circles within its rind. The estimated cost of the seven new lines is $37,000,000, which is at the rate of $1,120,000 a mile. The city of Paris is already authorized by Parliament to issue a preliminary loan of $33,000,000 for the metropolitan construction and permission will soon be obtained for a second loan of $35,000,000 for the same object. A calculation based on the traffic of the existing lines shows that the total number of passengers in a year on the whole metropolitan system when completed will be 352,000,000, which will yield the city a net annual profit of $4,000,000, which is deemed amply sufficient to justify the issue of a municipal loan of $120,000,000, a sum considerably more than is necessary for the construction. Some people are beginning to wonder whether the upper stratum of Paris will stand all this tunnelling. Several years must, however, elapse before the colossal scheme can be carried out.

MULTIPLE CONTROL SYSTEM.—Among the patents of March 25 is one granted to H. Ward Leonard which is of much interest. The patent relates to the application of the Ward Leonard system of motor control to electric traction, and a complete system of control circuits and devices is described. As is well known, the Ward Leonard system of motor control, which has been largely applied to elevator, machine tool and other work, consists in furnishing a source of variable e. m. f. to a motor supply circuit, which is done by varying the strength of the field of the supply generator. The patent relates to the application of this system to railway motors, the car being supplied either with alternating or direct current. Assuming that the line supplies polyphase currents, these currents drive a motor on the car, upon the same shaft of which is a direct-current generator which in turn supplies current for the car motors. In the case of a train only one of a number of cars may be supplied with such a motor generator, or two or more as may be desired. In any case, a line of either three or four conductors extend throughout the train and all the car motors can be controlled in an extremely simple manner from any car of the train. In the simplest form, a small exciter is attached to the shaft of the motor-generator and supplies the fields of the car motors, and the control circuit, the car armatures deriving their currents from a circuit supplied by the direct-current side of the motor-generator. In this case there are four conductors, two of which supply the motor fields and two supply the generator field. In each of the cars of the train—and if desired, at each end of each car—is a rheostat across the control line. When the train is at rest all of the rheostats are at the neutral point, and when it is to be put in motion the control of the entire train is effected by means of the rheostat at the point selected, the other rheostats remaining neutral. One arrangement is described whereby the number of train conductors is reduced to three. A description is also given of the application of the system when a direct-current source of supply is employed, in this case the same inventor's counter e. m. f. system of control being used. The patent specifications bring out the very simple nature of this method of control as applied to electric traction, which method permits the speed to be varied from the smallest to the highest rate or reversed without any sparking and with a maximum of electrical efficiency. The car motors may either be connected all in parallel, or the series-parallel method may be employed. The patent carries sixty claims.

LETTER TO THE EDITORS.

A Direct Steam-Electric Conversion Cell.

To the Editors Electrical World and Engineer:

SIRS:—Some years ago, the writer designed a homopolar electric generator which it was his intention to construct and test. Not having had an opportunity of doing so, a description is here given of the device in the hope of eliciting the opinions and criticisms of others who are interested in the production of direct current.

Fundamentally, this "homopolar cell," as it may be called, consists of a mass of conducting liquid revolving as a continuous cylindrical surface, in a uniform magnetic field, the magnetic lines of force parallel with the plane of revolution and at right angles to the direction of motion of the liquid at any given point. Under these conditions there will be an electrical difference of potential between the ends of the revolving liquid cylinder varying directly as the length and velocity of the cylinder and the density of magnetic force per unit area.

A commercial cell which fulfills the fundamental conditions can be constructed as follows:

A mass of mercury is driven by jets of steam at such a velocity that it assumes the form of a short continuous cylindrical shell or hollow cylinder inside a horizontal circular "race" or trough. The race extends around the inner periphery of a ring made up of alternate

thin rings or laminæ of soft iron and an insulating material; the two end laminæ or flanges are of thicker polished steel projecting inwardly for the double purpose of retaining the mercury and acting as positive and negative collecting rings. The laminated ring serves as one magnetic pole from which the lines of force pass radially through the mercury to the other pole, which is situated as close to the inner periphery of the mercury as the steam arrangement will allow. The electromagnet in its entirety resembles the ordinary ironclad portative magnet.

By reason of the short magnetic circuit a very high magnetic density may be employed. The mercury can readily be driven at a velocity exceeding two thousand feet per second. A single "homopolar cell" would therefore be capable of generating a voltage sufficiently high for commercial direct-current applications.

With a smooth "race" and polished collecting rings the frictional and electrical resistance losses will be low. Losses of heat energy by condensation and radiation are negligible.

A high initial and low terminal temperature of the steam may be secured, indicating a high thermal efficiency. The energy conversion will be large per unit weight and cost of cell.

To the writer the element of doubt is the efficiency of the conversion of the kinetic energy of the steam into the kinetic energy of motion of the mercury.

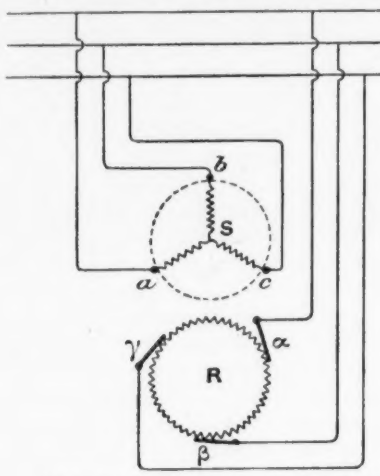
W. A. MARKEY.

SAGINAW, MICH.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Shunt Alternator.—LATOUR.—After having described the invention of an induction motor with power factor equal to unity and of a self-exciting alternator by Heyland (which were noticed at great length in the Digest) *L'Ind. Elec.* gives a review of the simultaneous and independent inventions of Marius Latour. This first article deals with a self-exciting shunt alternator. As shown in the adjoining diagram, such a machine, which operates on a net-



SELF-EXCITING SHUNT ALTERNATOR.

work *L*, consists of an ordinary secondary stator *S*, which may be connected in star, and of a primary rotor *R*, provided with a direct current dynamo armature winding and a collector. The exciting currents are taken from the network and supplied to the rotor by means of the three brushes. If the exciting currents are supplied directly from the network, without an intermediate transformer, the rotor winding must be able to stand the voltage of the network without burning through. There are many analogies with a direct-current shunt dynamo. In the latter theoretically the position of the brushes must be regulated when the load is varied, in order to have the commutation taking place on the true neutral line. In the same way in his shunt alternator, the position of the brushes must be adjusted for variations of the inductive or non-inductive load, in order to keep up the synchronous running of the rotor, to which it is due that the short-circuited coils are not the seat of an induction phenomenon. If one does not change the position of the brushes when the load is suddenly changed, the frequency of the alternator decreases, and, on account of this change of frequency and the resulting slip, the change of the load does not cause a drop of the tension of the same order as is found in ordinary alternators, but the machine now operates at variable frequency. This is for his shunt alternator. But he adds here that his compound alternator keeps the frequency practically constant for a fixed position of the brushes. This shunt alternator operates sensibly synchronously. He has proved that, supposing the currents and the distribution of the flux in the rotor are sinusoidal, there is no inductance of the rotor at synchronism and the commutation is perfect at synchronism. In practice, however, currents and flux are not sinusoidal; there would appear to be a possibility that the rotor is the seat of an irregular field, due to higher harmonics, but he shows that the rotor winding itself acts like a perfect "amortisseur" for these harmonics. His conclusions are also valid when the excitation is made by means of a transformer, or for special windings on the stator. The exciting currents supplied from the network to the rotor enable one to run the alternator with a power factor equal to unity. A self-exciting shunt alternator running as motor, has at the same time the advantages of the synchronous motor and of the non-synchronous motor. Its only disadvantage is a collector. But a convenient tension of excitation will always allow reducing the dimensions of the collector to small values; the energy commutated will always be small, as it represents only the true power consumed for the excitation. The main conditions for sparkless running are fulfilled.—*L'Ind Elec.*, Feb. 25.

REFERENCES.

Properties of Collector Rings.—POINCARE.—A mathematical discussion of the properties of collector rings. The theory is of importance for the understanding of Latour's and Heyland's invention of induction motors with power factors equal to unity, etc. The article is, however, too mathematical to be abstracted.—*L'Eclairage Elec.*, March 1.

Shunt Regulators.—KAHN.—A critical note on Krause's article recently abstracted in the Digest.—*Elek. Zeit.*, Feb. 20.

KRAUSE.—A brief reply to Kahn.—*Elek. Zeit.*, March 6.

POWER.

REFERENCES.

Elevators.—COOPER.—An abstract of a paper read before the Inst. of Jun. Eng. on the electric passenger elevators; he describes the hoisting machinery, the controller, and various safety devices.—*Lond. Elec.*, Feb. 28.

Electric Drills.—HENBACH.—The first part of a long illustrated paper in which he gives a review of the development of the electric drill.—*Zeit. f. Elek.*, March 9.

TRACTION.

Negative Boosters for Alternating Current Railways.—ZIEHL.—An illustrated account of experiments in which he examined the system proposed by Kapp, of inserting negative boosters at different places along the road, in order to diminish the earth currents. With alternating current, such a booster is a simple transformer, the two windings of which are bifilarly wound, i. e., their ampere-windings act against each other. The arrangement of the experiments is the same as that shown in the abstract of Krogh's paper, in the Digest last week. The experiments were made in the laboratory, the rails and the earth being represented by suitable non-inductive iron resistance. By varying the number of turns in one winding of the transformers and hence also the ratio of the numbers of turns of both windings, he obtained the following interesting result. According to the value of the ampere-winding acting against each other, the e. m. f. induced in the transformer winding may be positive or negative, i. e., producing or consuming volts; volts are always produced in that winding, the ampere-windings of which are overcome by

those opposed. It follows that by properly choosing the ratio of the turns of both windings, it is possible to make the earth current *I* either positive or negative or zero. He concludes that such transformer boosters, as they need no attendance, would be very suitable for alternating current railways.—*Elek. Zeit.*, Feb. 20.

Cost of Electric Motive Power.—Adams.—A statistical article in which he investigates to what extent differences exist in the cost of electric motive power per car mile on different roads. His statistics refers to all the roads of Massachusetts, where the average cost in 1900 was 2.04 cents per car mile. In Boston the cost was 1.36 cents; the average of all the roads outside of Boston, 2.64 cents, hence nearly twice as great than in Boston. A table gives the statistics of all roads. It shows a great variation in cost; the extremes are 1.31 cents on the Newton & Boston road and 5.71 cents on the Worcester & Webster road. A low cost is not confined to the largest systems, nor is an excessive cost peculiar to the smaller roads; although a low rate of cost of motive power is more frequent among the larger roads, probably because the larger systems more frequently adopt methods of construction and operation that lead to high efficiency than do the smaller roads. The table also shows that heavy passenger traffic cannot account for the great differences in the power rates.—*St. R'y. Rev.*, March 15.

Surface Contact System.—Paul.—A communication on the inherent disadvantages of surface contact systems with purely magnetic contact devices. The numerous accidents which have occurred with the Diatto system in Paris were due to the fact that the contact plugs remained live after the car had passed; the contact devices do not work without sparks; the contact plug is retained by permanent magnetism for some time; and it takes some time before the contact knob becomes dead. He claims this is an inherent disadvantage of all magnetic contact devices, but is avoided in those with electromagnetic contact devices, like that of Schuckert & Company.—*Elek. Zeit.*, Feb. 20.

Electrolysis by Tramway Return Currents.—Lubberger, Viggier, Michalke.—Three communications referring to a recent German abstract of a French paper of Claude (abstracted in the Digest, Sept. 15, 1900). Lubberger obtained results which agree in some points with those of Claude; for instance, the stray currents flow through the earth and only a part enters the water and gas pipes; but he disagrees with him in an essential point and says that the difference of potential between rails and pipes does not determine the danger of electrolysis.—*Elek. Zeit.*, Feb. 27.

Vigier shows that the actual conditions on a tramway are different from the conditions of the experiments of Claude.—*Elek. Zeit.*, Feb. 13.

Michalke also criticises Claude's methods; he agrees, however, that it was practically important to prove that not all stray currents in the earth enter the pipes.—*Elek. Zeit.*, March 6.

Automobiles.—A description of the electric motor cars which were exhibited at the Crystal Palace in London. Besides delivery wagons of German make, there were exhibited the new vehicles of the Brit. Electromobile Co. The frames are of channel steel construction. Two single reduction motors are used, being spring-suspended on the fixed rear axle. The Leitner battery is used. Each vehicle is equipped with three brakes; the emergency electric brake applied through the controller; the medium electric brake due to recuperation, and the pedal-operated band brakes, on drums on the hubs of the rear road wheels.—Lond. *Elec. Rev.*, Feb. 28.

REFERENCES.

Great Northern and City Railway.—A description of this road, which is one of the underground railways in London which is being built. The tunnel construction is described in detail. The tunnel during construction is lighted by electricity, and electric motors are used for operating the winding, ventilating and pumping machinery. The cars will be run in trains of 7 cars each, of which 3 cars will be equipped with motors.—*St. R'y Jour.*, March 1, and *Int. Ed.*, March.

Providence.—An article on the design of a power station in Providence, which is to have a capacity of nearly 6000 kilowatts. The description deals especially with the mechanical part of the equipment.—*St. R'y. Jour.*, March 1, and *Int. Ed.*, March.

Double Trolley Omnibus.—An illustrated description of an omnibus line, near Dresden, Germany, on which the omnibus is driven, by electricity, and takes current from two overhead wires, no rails being used, as was recently noticed in the Digest.—*St. R'y Jour.*, March 1, and Int. Ed., March.

Paris Exposition.—Tripier.—Continuations of his extremely long illustrated article on the electric railroad at the Paris Exposition in 1900. The power station is described in the greatest detail.—*L'Eclairage Elec.*, Feb. 1, 8.

Installations. Systems and Appliances.

REFERENCES.

Lightning Arresters.—Klein.—An illustrated translation of the German article on horn lightning arresters with iron framing, which was noticed in the Digest.—Lond. *Elec.*, March 7.

Railway Shops.—An illustrated article on light and power at the Colorado & Southern Railway shops in Denver. There are three 85-kw, 250-volt direct current dynamos for supplying a 220-volt lighting and power service.—*West. Elec.*, March 8.

Electro-Physics and Magnetism

Radio-Activity and the Electron Theory—Crookes.—A Royal Soc. paper. Electrons emanating from radio-active bodies behave like material particles and are impeded by the molecules of the surrounding medium, in contrast with ether waves, which are not thus affected except by absorption. He describes an experiment showing that the electrons from actinium partake of the properties of a fog or mist of material particles, capable of diffusing away in the free air like odoriferous particles, when not kept in by a thick metal screen. Emanations from polonium show an entirely different behavior as regards diffusibility through air, while electrons from radium and thoria behave similarly to actinium. Electrons from radium pass through aluminum and a considerable length of air, and affect a sensitive film; experiments on this point were tried with polonium, and it was found that air offered great obstructions. The electron theory explains a fact which has long puzzled experimentalists; it is well known that if a coin is laid on a sensitive plate in perfect darkness and connected with one pole of an induction coil for a few seconds and the plate then developed, an image can be obtained of the raised parts of the coin; this has generally been explained by saying that the electrified stream of air, or the brush discharge, affects the film like light; but Sanford has shown that coins embedded at the centre of a block of paraffin 2 cm. thick, where they could not send off streams of electrified air, can still be photographed by means of the induction coil; under these circumstances it is probable that electrons are the agents, as electrons will easily pass through paraffin wax from the coin to the sensitive plate, when the coin is connected with the negative pole of an induction coil, the other pole being connected with a metal plate placed below the wax block. He gives some facts in favor of Strutt's theory that positive ions as well as negative electrons flow off from a radio-active body, and that the non-deflectable and easily absorbable kind of Becquerel rays are heavy positive ions. Of the three radio-active bodies, radium, actinium, and polonium, actinium appears to emit corpuscles almost entirely of the penetrating, deflectable kind, polonium, rays of the non-deflectable, non-penetrating kind, whilst radium emits rays of both kinds; corpuscles from polonium therefore may consist of the heavy positive ions.—Lond. *Elec.*, March 7.

Electric Waves from the Sun.—Nordmann.—An account of experiments made at the station of Grands-Mulets, at an altitude of 3100 meters, to find whether the sun emits electromagnetic waves. The results were entirely negative. The sun, therefore, either does not send out Hertzian waves or they are completely absorbed by the sun's atmosphere or by the upper strata of the earth's atmosphere. Such an absorption is exceedingly probable, as we know that Hertzian waves are largely absorbed by rarefied gases.—*Comptes Rendus*, Feb. 3; abstracted in Lond. *Elec.*, Feb. 21.

Transfer of Radio-Activity.—Rutherford.—An investigation of the power of thorium and radium, of communicating a secondary radio-activity to all bodies in their neighborhood. The active rays of thorium and radium behave in every way like radio-active gases or vapors. He is of the opinion that the carriers concerned in the transfer of radio-activity are positive ions. He measures the velocity of the carriers with the aid of an alternating electric field and shows that their velocity is practically the same as the velocity of the positive ions. That the ions are positive is proved by the fact that they follow the potential gradient from a higher to a lower potential. The amount of secondary radio-activity is quite independent of the chemical nature

of the body upon which the radio-active ions are deposited. The deposit may even be chemically separated from the surface and condensed by evaporation.—*Phys. Zeit.*, Feb. 15; abstracted in Lond. *Elec.*, Feb. 28.

Chemical Effect of Cathode Rays.—SCHMIDT.—A paper on the fact that cathode rays are capable of decomposing substances sensitive to light. When the cathode rays, which consist of negative electrons, impinge upon a salt such as chloride of silver which consists of a positively charged silver atom and negatively charged chlorine atom, the electron can only be retained by the salt if it saturates a valency charge of the silver. The latter is then no longer able to bind two atoms of chlorine, and therefore one of them escapes to join a positive electron and to form an indifferent neutral atom of chlorine. If this theory is correct, it follows that cathode rays must reduce all compounds which contain volatile acid radicles. He has tested this conclusion and found it confirmed throughout. He succeeded in establishing cases of three different metallic valencies, comprising chloride of iron, chloride of mercury and sub-chloride of mercury. If the salts have non-volatile radicles, like the sulphates of barium and strontium, the cathode rays only produce a dissociation and only a very slight reduction, if any.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, Feb. 21.

Moving Ions as Ionizers.—STARK.—An article on the ionization of gases by ionic collisions. In a gas subjected to electric stress the positive and negative ions are set in motion in opposite directions. All along their free path they acquire and accumulate kinetic energy, and on collision with neutral molecules this kinetic energy is converted into the work of ionization. Since the negative ions are usually electrons and are in any case smaller than the positive ions, their mean free path is longer than that of the latter, and since the charges are the same in both cases the kinetic energy, and consequently also the ionizing power of the negative ions is greater than that of the positive ions. In a vacuum tube there is ionization wherever there is light. Under suitable conditions the cathode electrons produce ionization at a certain distance from the cathode, and the ions thus produced travel farther away under the influence of the electric field until they have acquired sufficient energy to produce ionization themselves, and so on. This accounts for the stratification of the positive light. He also applies the theory to the electric arc.—*Ann. der Phys.* No. 2; abstracted in Lond. *Elec.*, Feb. 21.

Rotary Fields.—CHABOT.—A generalization of the theory and practice of the rotary field. The ordinary rotary magnetic fields rotate in one phase. He combines two or three rotary field rings at right angles to each other. He has constructed a model of three such circuits and suspended an electromagnet within it by means of a Cardani suspension. A similar system which he calls the receiver is placed at a distance and communicates with the first, but a needle of soft iron is substituted for the electromagnet. When the latter is excited by an alternating current the needle follows any rotation that might be imparted to the electromagnet.—*Phys. Zeit.*, Feb. 15; abstracted in Lond. *Elec.*, Feb. 28.

Visible Magnetic Tubes of Force.—PELLAT.—A description of an arrangement in which cathode rays are made to trace out exactly the course of a magnetic tube of force in a vacuum tube brought into a magnetic field. At certain pressures and at certain high densities of the magnetic field, the bundle of cathode rays issuing from a plane cathode takes the shape of the tube of force having the cathode for its cross-section. The tube of force is thus traced through the tube along its whole extent, since the luminosity, due to cathode or canal rays, proceeds from the cathode in both directions. The cathode rays concerned in this phenomenon are different from those which undergo the ordinary magnetic deflection.—*Comptes Rendus*, Feb. 10; abstracted in Lond. *Elec.*, Feb. 28.

Electric Spark in Water.—TROWBRIDGE.—An illustrated article on the brilliant discharge which can be produced even in carefully distilled water if a high e. m. f. is used. He found 500,000 volts with a large capacity to be suitable for the purposes of spectrum analysis, an additional spark gap being provided outside of the liquid. The electrodes were platinum wires inserted in long glass tubes and were placed an inch apart. It seems almost as if the brilliant light were due to the incandescence of a solid. He is inclined to attribute it, certainly in part, to the combination of oxygen and hydrogen produced by the dissociation of the water.—*Elec Rev.*, Feb. 22.

Spontaneous Ionization of Gases.—WILSON.—While it has previously been shown that there is a continuous production of ions in air contained in a closed vessel, even when it is not exposed to any ionizing agent, the author has measured the relative rates of production of ions under such conditions in air and certain other gases. The following were the relative ionizations found: air, 1.00, hydrogen 0.184, carbolic acid 2.64, and chloroform 4.7. Except in hydrogen, the ionization is very nearly proportional to the density of the gas.—*Proc. Roy, Soc.*, Jan. 31; abstracted in Lond. *Elec.*, Feb. 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrometallurgical Industries of Germany; Deposition of Zinc.—A statistical review. There are four sodium plants; two use the Castner process; two the Rathenau and Suter process; one plant makes sodium for the production of cyanides and sodium peroxide, caustic soda being the raw material. There are seven copper works; the total copper production of Germany has increased from 24,700 to 32,000 tons in the last ten years. Some interesting notes are given concerning the Papenburg works; while it has been generally supposed that the Hoepfner copper process is there in extensive use, it is said that only a small quantity of copper is produced there at present and that probably the production of copper at that plant will be given up, "because copper nickel matter is not available"; the original Hoepfner process as it has been used in the Weidenau trial plant, is described in detail; the process is said to have been modified later. The Elmore process, in use at Schladern for making copper tubes, is said to have reached remarkable perfection. At a Hamburg refinery about 3000 kgr. of fine gold are produced yearly by the Wohlwill process, the anodes being of raw gold, 980 fine, with impurities of platinum and silver; from the sludge about 12 to 15 kgr. of platinum are obtained. Besides this, still greater quantities of Transvaal gold, down to 850 fine, are electrolytically refined. The electrolytic zinc industry is still in its infancy; in most works the operation has ceased. He makes some interesting remarks on the electrolytic deposition of zinc from solutions. The deposition of pure solid zinc is impossible, if the solution contains many impurities. Zinc is more electropositive than hydrogen and can be obtained from neutral or slightly acid solutions only for the reason that a higher e. m. f. is required to make a hydrogen ion give off its charge at a zinc electrode, than at an electrode of most other metals (he evidently means, on account of the "Ueberspannung"). If the solution contains impurities of metals which are more electronegative, these are preferably deposited with the result that the cathode is then no longer pure zinc, but is mixed with other metals by which a hydrogen ion gives off its charge more easily than a zinc ion. The most dangerous impurity is iron. He refers to the troubles in the analytical examination of zinc by electrolysis if iron is in the solution: as long as there are much more zinc ions than iron ions, zinc is deposited; but when the ratio of the number of iron ions to that of zinc ions reaches a certain value, iron is deposited together with the zinc; the cathode then contains iron, and at this iron hydrogen ions can give off their charges more easily than zinc ions; zinc is dissolved with vivid development of hydrogen and disappears from the platinum pan. He brings this into connection with the influence of current density upon the form of the zinc deposit. When a pure zinc salt solution is electrolyzed with a pure zinc cathode, zinc is deposited and hydrogen appears only at very high current densities. If, however, the solution contains iron ions, iron is deposited preferably and at the ion deposit, thus formed, hydrogen gives off its charge preferably at low current density, and hydrogen together with zinc at medium current densities. If, however, the current density is great enough, the small iron particles on the cathode are quickly covered with zinc, so that the cathode becomes again pure zinc and no hydrogen is given off; only at very high current densities are zinc and hydrogen again deposited simultaneously. This may be the reason why from pure solutions, a good zinc deposit is obtained at low and medium current density, and spongy zinc at very high current densities; on the other hand, from impure solutions as they exist in practice, spongy zinc is obtained at low and very high current densities, and a good zinc deposit at medium current densities.—*Zeit. f. Elektrochemie*, March 6.

Fusion of Quartz in the Electric Furnace.—HATTON.—An abstract of a paper read before the Manchester Literary and Phil. Sos. He draws attention to the possible use of fused quartz for making vessels in which to study the properties of substances at high temperatures, and more especially for high temperature gas thermometers. He uses a furnace requiring 300 amp at 50 volts, the arc formed

causing the quartz to melt within a minute or so. He produced thick-walled tubes of quartz, having a core of about ⅛ in. diameter, and although they were not entirely free from bubbles, their appearance was much improved by reheating under the arc.—Lond. *Elec.*, March 14.

Electrolysis of Water and Industrial Uses of Oxygen and Hydrogen.— M. U. Schoop.—An abstract of a paper read before the Elec. Soc. of Cologne, on the industrial electrolysis of water. Lead or iron electrodes are used; if iron, the electrolyte is a solution of hydroxide of potassium or sodium. It is important to prevent the dangers resulting from the mixing of the gases; for this reason diaphragms are required; they are made of porous insulating material. The hydrogen obtained by electrolysis generally contains 2 or 3 per cent of oxygen, the oxygen about 2 per cent of hydrogen; both gases also contain slight quantities of steam. The easiest and best method of testing the purity of the gases is by determining the velocity of sound in them. The chief obstacles to the commercial sale of electrolytic oxygen and hydrogen are the high price of the steel bottles and the cost of transportation. In the manufacturing plant at Cologne, the cost of producing hydrogen, including amortization of the apparatus, is about 10 cents per cubic meter. Oxygen is used commercially for therapeutic purposes, oxygen and hydrogen for the method of soldering and welding by means of oxy-hydrogen gas which he believes to be better than the electric process. Oxygen and hydrogen may also be used for lighting purposes, especially in cottages, etc.—*Elek. Zeit.*, Feb. 13.

REFERENCES.

Electrolytic Production of Soda and Bleach.—An editorial note on the success which has attended the commercial manufacture of soda and bleach by the Electrolytic Alkali Company, at Middlewitch, England, so that it has been decided to extend the works and double the output. The success is said to be the result of the successful experimental working of the Hargreaves-Bird process at Farnworth. Several illustrations of the plant are given, together with a diagram of the Hargreaves-Bird cell.—Lond. *Elec.*, March 14.—Longer illustrated articles on this subject in Lond. *Eng'in and Elec. Eng.*, March 14.

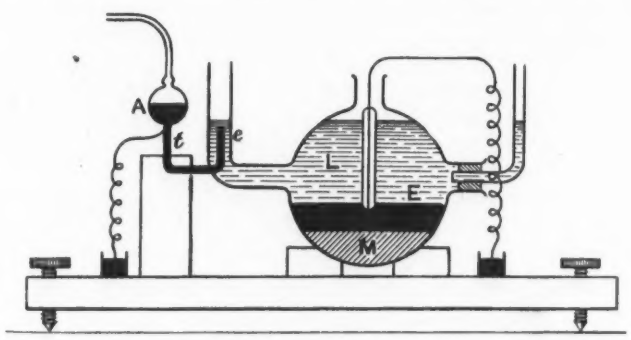
Electric Furnace.—Liebman.—An illustrated article on a modified Moissan electric furnace which is inexpensive and especially suitable for demonstration purposes, as the different methods of electric heating can be shown in it.—*Zeit. f. Elektrochemie*, Feb. 27.

Automatic Switch for Storage Batteries.—Thieme.—An illustrated description of a new automatic switch for keeping the voltage of a storage battery constant, by disconnecting or adding cells.—*Elek. Zeit.*, Feb. 27.

Parabolic Reflectors.—Rost.—An illustrated description of Cowper-Coles' electrolytic process of making parabolic reflectors for searchlights.—*Elektrochem. Zeit.*, March.

Units. Measurements and Instruments.

New Capillary Electrometer.—Boley.—A description of a new capillary electrometer of very general application. It is shown in the adjoining diagram. He has been led to the construction of this instrument because the capillary electrometer of Lippmann does not



NEW CAPILLARY ELECTROMETER.

operate with liquid saturated amalgams, as they are not sufficiently mobile in capillary tubes. The amalgam or mercury is contained in a bulb *A*, provided with a tube *t* bent twice at right angles. This tube has at the end *e* an internal diameter of about 1 m.m. and its section is polished. There the meniscus is formed so that the instrument may be called a "free drop electrometer." This meniscus is observed in the microscope. The emergent drop is surrounded by the electrolyte *L*. The tube *T*, which can be turned in its plug, serves for filling and emptying the apparatus. The electrode *E* rests upon a base of mastic *M;* on account of its large diameter of 12 c.m., it is practically unpolarizable. The instrument is easily adjustable. The meniscus should be lighted by a small source of light above it, so as to produce in the microscope "two or three black fringes parallel to the image of the summit." The microscope is set upon the fringe nearest the meniscus. For measuring e. m. f's. he uses the compensator of Bouty and a constant cell of the Clark type. With pure mercury 0.0003 volt gives an apparent depression of the meniscus of ⅛ m.m., with a magnifying power of 100. Up to 0.01 volt the depressions are exactly proportional to the e. m. f. The zero point is absolutely constant. With saturated silver amalgam, he obtained the same sensibility and about the same depressions of the meniscus; the meniscus of the amalgam is very mobile and its zero point is absolutely constant.—*Comptus Rendus*, Feb. 24; *L'Eclairage Elec.*, March 15; briefly abstracted in Lond. *Elec.*, March 14.

Determining the Instantaneous Angular Speed of Revolving Axles.—Hospitalier.—A description of a method for measuring instantaneous angular speeds, between 10 and 300 revolutions per minute, and determining variations of speed during one revolution. On the end of the revolving shaft there is pasted an inclined mirror, upon this mirror is sent a ray of light, in the direction of the shaft; the reflected ray describes a cone in the space; on a screen a luminous circle appears, being produced by a luminous point rotating on the screen in a circle with a speed which is at any instant proportional to the instantaneous angular speed of the revolving shaft. Between screen and mirror, a disk is revolved with uniform speed which has a circle of equidistant holes, say 60. Each of these holes allows the light ray to pass through only during a very short moment, and on the screen, instead of the continuous circle, a series of luminous points arranged in a circlee, is obtained. In the case of absolutely uniform speed of rotation, all these luminous points are equidistant; and variations in the angular speed produce differences in the distances between these luminous points. If only the extreme speeds are to be determined, it is sufficient to measure the maximum distance and the minimum distance between two points. The main advantage of the method is that no synchronism is required between the revolving axle and the measuring apparatus. It is only necessary that the disk with the holes is revolved with uniform speed during the experiment.—*L'Ind. Elec.*, Jan. 10.

Instrument for Maximum Demand Systems.—Hartmann.—An illustrated paper read before the Elec. Soc. of Berlin, in which he describes an instrument for automatically disconnecting a house installation from the public network when more than a pre-arranged maximum current is being taken from the mains. The instrument is essentially an automatic circuit breaker which, when the current exceeds a certain limit, alternately opens and closes the circuit, until the normal current has been restored. The purpose of this instrument is therefore to enable the installation of a limitless number of lamps, but to guarantee at the same time that not more than a certain number of lamps are lighted simultaneously, so that a flat rate may be charged, while the principles of the maximum demand system are observed.—*Elek. Zeit.*, Feb. 20.

Resonance Phenomena.—Trylski; Schlee.—Two communications referring to the paper of Benischke, recently abstracted in the Digest. Trylski notes briefly that the pointer of a Weston wattmeter always began to oscillate strongly when the frequency got a certain value between 44 and 48; he believes this was a resonance phenomenon. Schlee has also often made the same observations on wattmeters and other instruments; he also considers this to be a resonance phenomena, so that the critical point could be displaced by a change of the moment of inertia of the movable system.—*Elek. Zeit.*, Feb. 13, 27.

Telegraphy. Telephony and Signals.

Wireless Telegraphy.—Slaby.—The first of several illustrated papers on "the scientific principles of spark telegraphy." He deals with oscillations in straight wires and first describes some fundamental experiments on the production of the oscillations and then gives a mathematical theory for the explanation of these experiments. From the source of high voltage the wires are charged with energy

and this form of energy changes into magnetic or "flowing" energy; the condition of oscillation, started in this way, is characterized by a continuous change of energy between these two forms. The action into the distance is due to the "flowing" form of energy and follows the well known laws of induction. It follows that for the action into the distance the "flow" should be linear, so that the use of long, straight and parallel wires is the characteristic feature. In the second part of the article he discusses the oscillations in the receiving wire, under different arrangement. Incidentally he remarks that practice has shown that the available earthed conductors, like lightning rods on steeples, have been found suitable for receiving messages.—*Elek. Zeit.*, Feb. 27.

Registration of Thunderstorms.—Fenyi.—A description of the following arrangement for the automatic registration of thunderstorms. A coherer and a coil are inserted in the circuit of a cell. In the center of the coil is a magnetic needle which is deflected as soon as the coherer becomes conducting, and which then closes a registration circuit. The latter contains an electric bell whose vibration suffices to decohere the instrument. Lightning discharges produce an effect upon the instrument even from considerable distances. The coherer consists simply of two sewing needles laid one upon the other; they are said to form a particularly effective coherer.—*Comptus Rendus,* Jan. 27; abstracted in Lond. *Elec.*, Feb. 14.

Galvanometric Observations of Thunderstorms.—Landerer.—A description of the following apparatus used by him at Tortosa for observing and locating distant thunderstorms. A telegraphic line, 300 yards long, was run in a N. N. E. direction, put to earth through the water pipes of Tortosa, and joined to a galvanometer capable of showing the ten-millionth of an ampere. It was found that when the lightning flashes over the distant mountains, the spot of light undergoes a double shock. The first shock has a small amplitude and the second shock is in the opposite direction and has a large amplitude. He has observed that during the same storm the small deviations are always in the same direction, the discharge proceeding from north to south in the case of storms taking place east of the meridian, and from south to north in the case of storms in the West. This method has enabled him to record a storm 150 miles distance.—*Comptus Rendus,* Feb. 3; abstracted in Lond. *Elec.*, Feb. 28.

Miscellaneous.

Treatment of Tuberculosis.—Kaiser.—An account of experiments in which he attained some remarkable results by treating pulmonary consumption and other diseases with pure blue light, by means of an arc lamp concentrated through a lens containing methylene blue or through glasses giving blue light of equal purity.—*Wiener Klin. Wochenschr.*, No. 7; abstracted in Lond. *Elec.*, March 14.

Shocks at 500 Volts.—Some results of tests in which a large number of persons were inserted in 100 to 500-volt circuits and the current was measured. Connections were made finger to finger, finger to foot, and foot to foot. A practical result of the finger-to-foot tests is that over 90 per cent of the persons tested would be able to take hold of the trolley wire of a tramway system without harm.—Lond. *Elec.*, March 14.

REFERENCE.

Russian Electrical Engineer.—Vetterlein.—An article on the second Congress of Russian Electrical Engineers, held in Moscow, from Jan. 10 to 18, 600 members were present and 100 papers had been announced. There was also an exhibition of electrical apparatus; 33 firms were represented. The titles of a number of the papers read, are noticed.—*Elek. Zeit.*, Feb. 27.

New Books.

Annuaire Pour L'An, 1902. Publié par le Bureau des Longitudes. Paris: Gauthier-Villars. 656 pages. Price, 1.50 francs.

This invaluable little pink volume contains a wonderful assortment of facts in physics, astronomy, chemistry and sociology. When one seeks in vain for information in these subjects one may frequently find solace and solution of the difficulty in the 750 odd pages of the "Annuaire."

Several interesting and important chapters are appended to the book. One of them is on Wireless Telegraphy by Poincaré, and another on Polyphase Currents by Cornu. A third is on the application of the decimal system of angular measurement (90° = 100 grades) to practical navigation, and a fourth is on the observatory at the summit of Mont Blanc.

Poincaré points out that the elevation of the wireless telegraph mast should be proportional to the square root of the distance of communication. He attributes the gain from increase in height to the length of the wave emitted, the wave length being proportional to the mast height, and long waves can be bent around hills or over the earth's convexity, more readily than short waves.

It is a pity to see all longitudes reckoned from Paris. There ought to be but one international meridian, and nearly all countries date from Greenwich, but it is to be hoped that when Great Britain adopts the international metric system of weights and measures, France will acknowledge the courtesy by adopting the international meridian of Great Britain.

A Handbook for the Electrical Laboratory and Testing Room. By J. A. Fleming, M. A., D. Sc., F. R. S., M. R. I. Vol. I. New York: D. Van Nostrand Company. 538 pages, illustrated. Price, $5.

Since the publication of Kempe's handbook on electrical testing, no work of similar pretensions has appeared. In this country Professors Carhart and Nichols have separately published laboratory manuals, which, while most excellent in their way, are not especially adapted for work outside of academic laboratories. The needs of the telegraph engineer are met in great part by Kempe's book, but the needs of the electrical engineering profession at large have not been thoroughly considered by any writer. There has been all along a growing demand for an appropriate book on electrical testing, yet while other lines of the technical literature of the profession have been developed, this has suffered a marked neglect. The announcement of a work of this character by the veteran writer, Professor Fleming, is one of no little interest at this time. The author is so well known through his volumes on the alternate-current transformer and various papers that the character of the present work might be anticipated from the author's well recognized peculiarities. There might be expected a certain prolixity, little regard to formal arrangement, and a pronounced absence of terseness in his mathematical thought, yet, withal, not a little of solid, practical worth might be looked for. In the volume before us these anticipations are realized, though this book is much the best one by the author in point of style.

The first volume, now published, treats of the equipment of the laboratory, and discusses the subjects of electrical resistance, current, e. m. f. and power. The second volume proposes a discussion of capacity and inductance, and electric quantity and energy, including battery and meter testing; magnetic testing of iron; photometry and lamp testing, and testing of dynamos, motors and transformers, and from the matter as outlined this will be the volume especially interesting to engineers. The author's arrangement is apparently lacking in balance. As one-third of the first volume is devoted to the arrangement and equipment of the laboratory, and the remainder discusses but four additional topics, it seems that too much has been left for the second volume. It would appear in advance that capacitance, inductance, quantity and perhaps energy should have found place in the present volume, leaving the entire second one to the measurements which are especially vital to the profession.

The writer announces in the preface that he will deal "more particularly with the requirements of electrical engineers, as distinguished from electrical physicists, and it is his aim to provide "critical discussions on the intrinsic utility of the various methods of measurement given."

Taking up the work in detail, the unusually lengthy discussion of the arrangement and equipment of the electrical testing room contains much that is suggestive and of real value. The author describes in great detail and at length his own electrical laboratories at University College, London; and this description, while interesting enough if met with in a technical periodical, is undoubtedly out of place in the present book. There follows much confused discussion and description of the standard electrical apparatus of a physical laboratory, all of which has the apparent purpose of setting before the reader the determination and verification of the fundamental electrical quantities. However, the chapter contains many excellent and valuable directions for the use of such apparatus as standards of resistance, standard cells and the like. As might have been supposed, much emphasis of space and description is laid upon the Kelvin balances, though we, in this country, can scarcely partake of the

degree of enthusiasm felt for this singular apparatus by the English physicist; but perhaps we have to thank Edward Weston for a superior equipment.

Following this is a chapter devoted to the topics involved in the comparison of electrical resistances. At the very outset, this chapter raises the question of the extent to which a book on testing shall be given to the philosophical discussion of the elementary principles of electricity and magnetism. As an introduction to the measurement of resistance the author enters into a lengthy discussion of the philosophical truth of Ohm's law, and that this discussion happens to be an especially good one does not make its appearance in such a work the more fitting. In a handbook on electrical measurements the verified statement of Ohm's law only need find place. In this the writer is not consistent with the statement of his preface, for such matters belong to electrical physics rather than to engineering. But this is as a very small thing compared with what follows immediately. The author here proceeds to lay down several theorems on networks of conductors and then engages in their elaborate demonstration, which drags on through a matter of some 15 pages of very fine print, which contain such an array of determinants and algebra that none but a physicist, or an engineer physically inclined, would peruse it. As the chapter is developed into the subject of the measurement of low resistance, but few methods are given, and these are of the older type. As a matter of course only methods which have originated in England find place, and the book is distinctly a loser through the disregard of many excellent methods and apparatuses which have been proposed in this country from time to time, and especially of conductivity sets which are so largely used industrially.

Professor Fleming's book is decidedly poorer by an almost studied exclusion of American methods and apparatus. Some references are indeed made to work done here, as the Rosa curve machine, but this seems to have met with favor, or perhaps came to the notice of the author, because its description was first given before the British Association.

One of the notable features of the book is the set of numerous tables relating to resistance constants, and though the majority are properly physical tables, it is seldom that so much interesting and valuable reference data are brought together.

The chapter on the measurement of electrical current devotes ample space to the discussion of voltametry with copper and silver and contains a popular rather than a practical discussion of absolute galvanometry for the measurement of current. For a work devoted to measurements "in the so-called heavy electrical engineering" (page 1), one would anticipate an adequate description and discussion of the prevailing types of ammeters. The Weston instrument comes in for scant notice and an illustration of its case, base and terminals, which is highly edifying, while the Hartmann and Braun hot wire ammeter is described at length and theoretically discussed. The brevity here is most singular, and the stress laid upon the Hartmann and Braun instrument is most surprising, for we who have used the instrument, have found it fragile, and subject to all the annoying drawbacks of its type. Then, too, in his description of the Weston instrument the author falls into a very peculiar use of language, stating that "the instruments are made in various grades, to read from milliamperes to hundreds of amperes" (page 369). This poor attempt at Latinized English when translated evidently means that the scales are graduated in various current intervals; only one grade, so far as we know, of the Weston laboratory instruments is manufactured.

The concluding chapter is devoted to the measurement of electrical power, and one naturally turns in such cases to the section dealing with power in alternating current, and more especially, polyphase circuits. The character of the discussion that awaits the reader here may be inferred from the fact that most of the references are taken from papers and discussions by Messrs. Ayrton and Mather. Still the chapter contains much that is valuable and suggestive, though it disappoints one rather more by its omissions, than its archaic treatment. As might be anticipated, the Kelvin balance again comes in for prominent mention, though the high inductance of these instruments make them so objectionable, even if they were otherwise desirable.

The book is very notable by reason of its frequent and satisfactory references. Under many important topics a reference sequence of valuable papers is given, and these are supplemented by numerous foot-notes. The book is thus scholarly, and, within the limits of provincialism, thorough. However, the author has again obtruded upon his readers the foolish practice of the use of large, together with very small type, for the convenience of one set of readers, who not relishing much mathematics and theory, may peruse the coarse print and be comfortably oblivious toward the forbidding matter in inconspicuous type, that so voluminously interlards the book. Such a practice of printing may do for a country so wholly under the sway of systems of examination, as England is yet, but it is annoying to readers who do not appreciate the archaic humor of such practices.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Interstate Independent Telephone Association. Next meeting, Chicago, April 9, 10 and 11, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

Iowa Electrical Assocaition. Next meeting, Cedar Rapids, Ia., April 9 and 10.

National Association of Manufacturers. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

Southwestern Gas, Electric and Street Railway Association. Next meeting, San Antonio, Tex., April 18-21, 1902.

Clark Wireless Telegraph.

The accompanying illustrations relate to the Clark wireless telegraph system as installed on board the steamer "City of Detroit," by means of which signals were successfully received over a distance of 117 miles. The instruments on the operator's table inside the cabin include a coil for transmitting, two large secondary frequency coils and a high speed circuit breaker, operating at a rate of 10,000 breaks per minute, with copper disks, oxide interrupter and cooling device.

Directly on the table is mounted the operator's key and sounder for transmitting messages. When the key is depressed a dot is formed, which sends a flow of current into the primary circuit of the large coil, causing rapidly alternating pulsations in the secondary frequency coils, which pass out through the heavy cables, and oscillate across space.

Fig. 4 shows the large copper balls and cones of transmitter, located on the hurricane deck of the steamer "City of Detroit." In the circuit are the differential frequency coils, a condenser and resonating drums, with the cables leading to the mast and aerial screens.

On the receiving operator's table (Fig. 2) is located the receiving apparatus, consisting of a coherer, automatic tapper, a 2000-ohm relay, condensers and differential frequency receiving and repeating coils. A telephone receiver is bridged in on the receiving circuit across the 3000-ohm coils, the receiving apparatus being compact and detachable, and so arranged that it is portable and can be removed

from the ship to the shore if so desired. The receiving wires lead in across a double-pole, double-throw switch to the cables for receiving and transmitting, which assists in a quick change from one system to the other.

Figs. 3 and 1 show the transmitting station and receiving station at

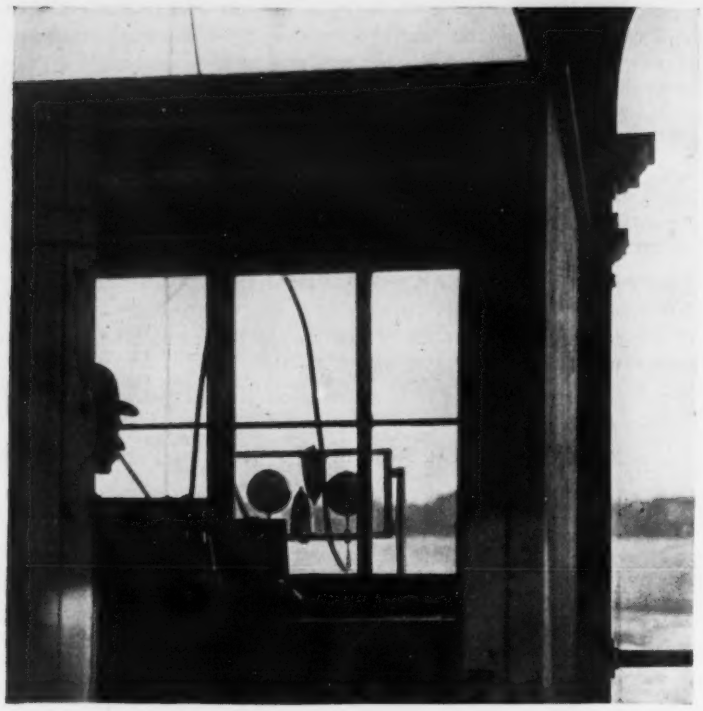


FIG. 1.—WOODWARD AVENUE STATION, DETROIT.

the foot of Woodward Ave., Detroit, Fig. 1 shows the inventor, Mr. Clark, sending a code signal to the "City of Detroit." It also shows the transmitter with the aerial cables leading to the aerial drums and screens on top of the station, Fig. 3. This system of wireless telegraphy is controlled by the Electric Service & Appliance Company, Detroit, Mich., of which the inventor of the system, Thos. E. Clark, is president.

New Siemens Projectors.

A new form of searchlight lately placed upon the market by Siemens Bros. & Co., of London, has been supplied in large numbers for use on board warships. The projectors are made in three different sizes, viz., for mirrors of 16 in., 20 in. and 24 in. diameter, and their special features consist in the use of automatic lamps; lenses capable of giving a variable horizontal dispersion; dark shutters for cutting off all the light; signaling shutters; and in the case of the 24-in. size, electric motor control of the different motions whereby the searchlight can be manipulated from a considerable distance.

The lamp employed is of the inclined pattern, and can be worked either automatically or by hand. It is made in three standard sizes, viz., 50-ampere, 75-ampere and 100-ampere. In these lamps the carbon holders are supported on a rod which has right and left-handed threads. Suitably placed outside the lamp case is a hand-wheel, by which the carbons can be moved together or apart by means of these threads. For hand control, therefore, it is only necessary to strike the arc in the ordinary way. For automatic working a solenoid is placed inside the lamp case, the exciting coils of which are in series

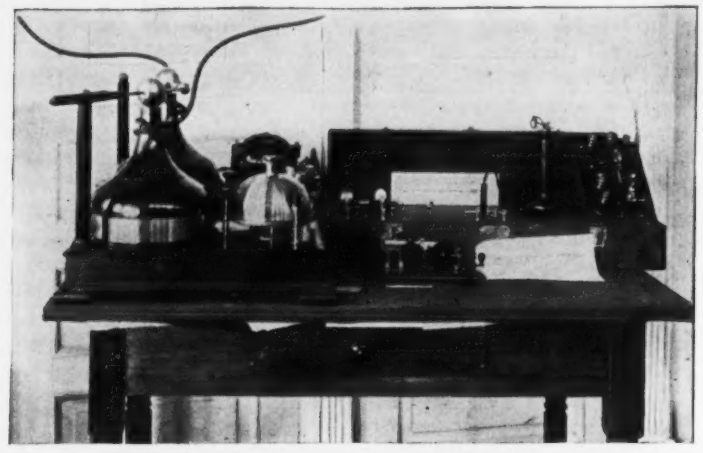


FIG. 2.—COMPLETE SET OF INSTRUMENTS ON STEAMER "CITY OF DETROIT."

with the carbons. This solenoid has an iron core which is connected with the carbon holders, the latter being arranged with a small amount of slip independent of the threads on the supporting rod. On the excitation of the solenoid the core is sucked in and so strikes the arc.

FIG. 3.—AERIAL CABLES, SCREENS, ETC.

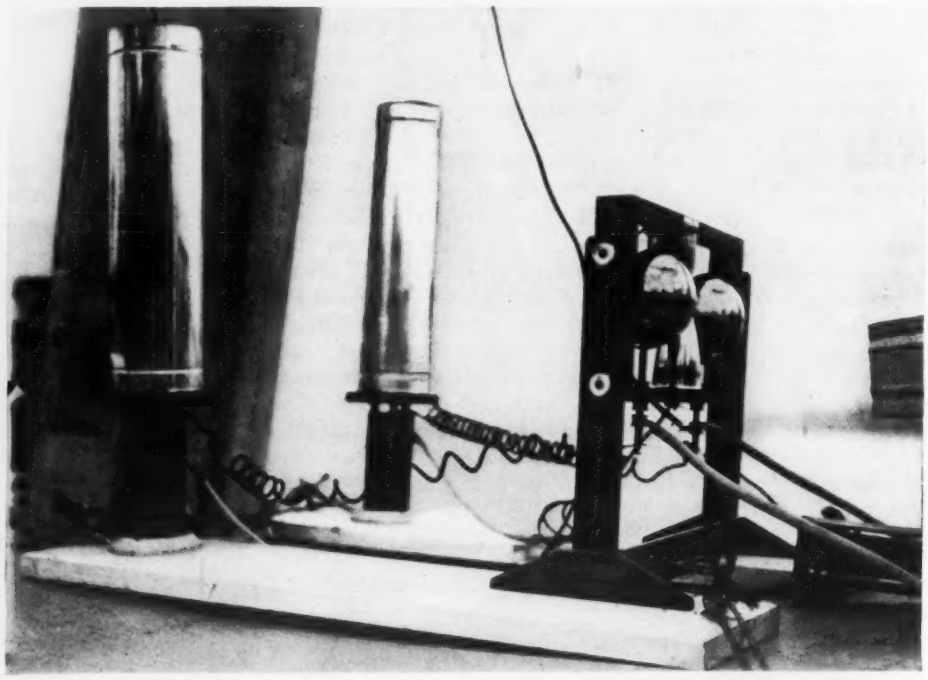


FIG. 4.—TRANSMITTER CONES AND BALLS ON "CITY OF DETROIT."

For the regulation of the feeding mechanism for maintaining the arc at the correct length, an electromagnet is provided. This electromagnet is wound with fine wire and connected as a shunt to the arc. When the resistance of the arc increases, due to the consumption of the carbons, the volts across the shunt electromagnet rise until, at a certain moment, the magnetization is sufficient to attract a soft iron armature controlled by a spring which carries a contact breaker. The armature therefore vibrates as long as the volts across the shunt coil are in excess. Each movement of this armature actuates the arm of

a friction clutch in connection with the supporting rod carrying the carbon holders, giving the same a twist and so bringing the carbons together, until the correct length of arc is obtained. The whole of this automatic gear can be switched out of action when desired.

This gear is perfectly steady and even in its action, and the lamp will run for several hours without attention. Screw regulation is provided so that the lamp may be adjusted in a vertical and horizontal plane, thereby ensuring correct focus.

The mirrors are of the well-known Mangin type, with focal distances of 10 in., 12½ in. and 17 in. for the 16-in., 20-in. and 24-in., respectively. The mirror cases engage with the projector barrel by means of bayonet joints, and are easily removable.

The diverging lens consists of a combination of two lenses, one formed of plano convex and the other of plano concave glass trips. Each of the two lenses is mounted in a gun-metal ring, which travels inwards or outwards upon three screws. The screws are rotated by means of a large gun-metal toothed ring worked by a hand-wheel at the side of the projector barrel, and the lenses are thereby racked towards or away from each other.

The relative positions of the lenses are such that when at their nearest point of approach the effect of the one is neutralized by the other, that is to say, the rays of light diverged by the convex lens are corrected and brought back to parallel by the concave lens.

At the point of greatest distance the dispersed rays from the convex lens intersect in the center of each strip of the concave lens, and the dispersion is therefore unhindered.

The effect is readily observed when the projector is in use, the rotation of the hand wheel causing the beam to spread out the shape of a fan, or to contract as may be required. Any dispersion up to an angle of 45 degrees can be obtained at will.

The signaling shutter is fixed outside the combination lens, and consists of vertical hinged louvres corresponding in number with the strips in the lens. These shutters are held open by means of a rod controlled by a coiled spring. The rod projects from the side of the projector and terminates in a knob. A small movement of the rod closes the louvres which open immediately the rod is released.

The apparatus is light and quick in action, even in the largest sizes, and flash signaling can be carried on with the utmost ease. In order to avoid interruption to the light the shutter is so arranged that each louvre when open is edgeways to and coincident with a joint between two of the lens strips.

The dark shutter is an essential for the satisfactory use of a projector on a warship, so that it shall be possible to obscure or turn on the beam suddenly. This cannot satisfactorily be effected by turning off or on the lamp, and it is evident that a shutter offers great advantages in this direction. To each of these projectors, therefore, is fitted an "Iris" diaphragm which opens and closes by means of a handle projecting below the projector body. The closing of this shutter instantly obscures the light and transforms the projector into a virtual dark lantern. When open the shutter falls back into a recess in the projector body.

The body of the projector is supported by sliding trunnions. It is provided with ample ventilation, the ventilator hoods being provided with lips which effectually prevent the escape of any reflected light. A focus observer is fitted consisting of a frosted glass disc, upon which an image of the arc is projected. This makes it possible to obtain an absolutely correct focus and adjustment of the arc without opening the doors, which give access to the interior of the body.

The signaling shutter, combination lens, and Iris diaphragm are severally detachable from the body, so that in the event of any one of these being injured, it can be instantly removed and the projector used without it. A plate glass front is fitted to the body behind the diaphragm for this purpose, and the sliding trunnions allow of the necessary compensation being made for balance. Locking gear is provided for each motion.

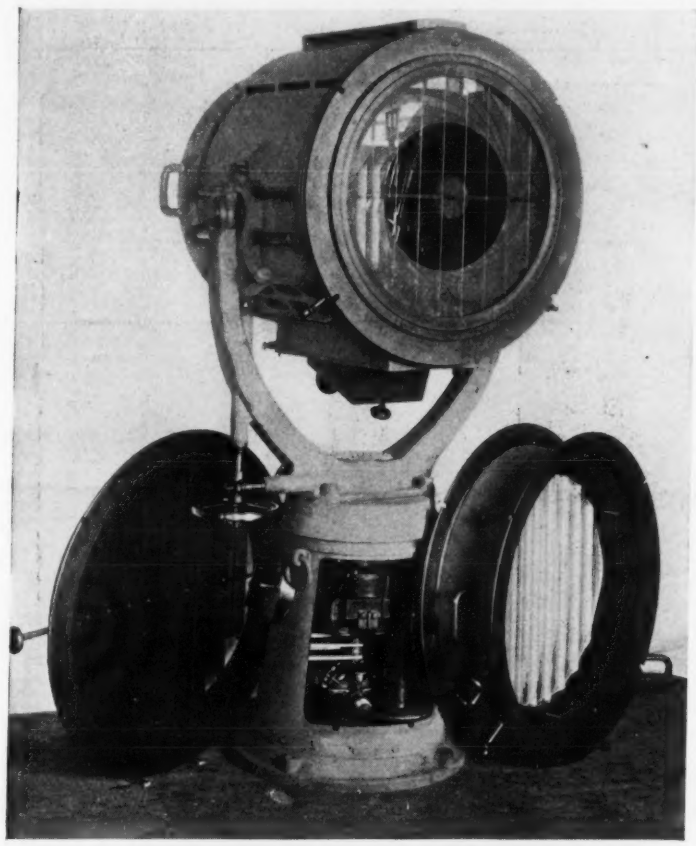


FIG. 1.—VIEW OF PROJECTOR, SHOWING DIAPHRAGM.

FIG. 2.—GENERAL VIEW OF PROJECTOR.

In the 16-inch and 20-inch sizes, the control is effected entirely by hand, but in the 24-inch size, both hand and motor control is fitted. The latter consists of two motors, one each for the horizontal and vertical motions. The motor for the latter is mounted upon the center spindle of the projector and travels round with it. This motor controls the vertical or tipping motion by means of a horizontal shaft and worm. The latter engages with a worm wheel which transmits the movement to the quadrant upon the body through a vertical shaft and bevel pinion.

The motor for the horizontal or slewing movement is fixed to the bottom of the hollow base and transmits the movement to the turntable through worm gear and a vertical shaft, the latter being fitted with a pinion engaging with a toothed rack upon the turntable.

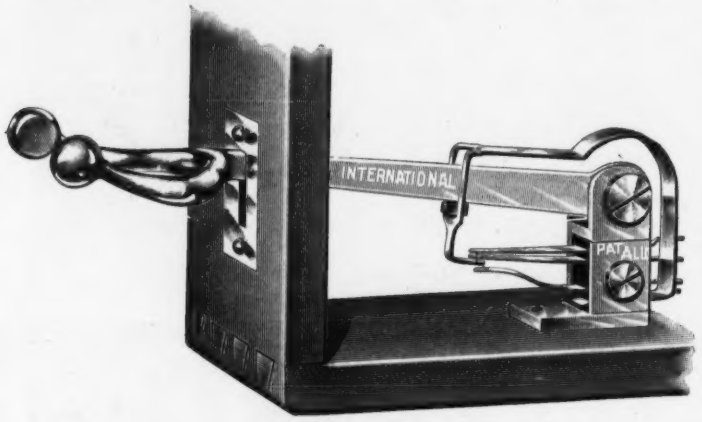
The controlling switch consists of two motor starting switches working in planes at right angles to each other, and operated by a common handle, the effect being that the projector follows the movement of the operator's hand, throwing the beam of light upwards

when the handle is elevated, and lowering the beam when it is depressed and so forth. This apparatus enables a projector to be placed in a commanding position, such as a fighting top, and at the same time to be controlled from another point of observation such as the navigating bridge or a gun casemate.

Telephone Switch Hook.

The telephone switch hook shown in the accompanying cut is being put on the market by the International Telephone Manufacturing Company, of Chicago, and is to be embodied in its complete line of central energy and generator call exchange and toll line wall telephones. The standard of the switch is constructed from a cast brass plate, forming the bottom, one side and top of the spring block holder, and also the base to which the hook is mounted. The spring block is of hard rubber, and is slotted to receive the necessary springs. The springs are firmly clamped into place by a heavy brass binding plate, fastened with a strong brass binding screw. The binding plate is insulated from the springs with a piece of heavy mica.

The springs are of heavy German silver, and are provided with platinum contacts. They are extended through the rubber block, and form the terminals for wire connections at the rear of the switch. The main spring is set into the base of the insulated block and is bent



SWITCH HOOK.

up over the back of the base over the hook, which passes through it and then extends down and back between the contact points. This arrangement furnishes one of the longest and most live switch hook restoring springs, leaving nearly 5 inches of German silver spring for tension. The shape of this spring and the manner in which it is mounted to the hook ensures a long sliding connection at the contact points, and the largest possible space between the contacts when opened by moving the hook up and down. This arrangement of the restoring spring leaves no rubbing or scraping of any part, excepting at the contact points, by a small hard rubber stud held in the slot of the spring and under the hook. The hook is insulated from the main spring. No part of the hook or base is used in the circuit.

The Wright Electrolytic Meter.

In a paper read last fall by Mr. J. R. Dick before the British Institution of Electrical Engineers it was pointed out that the electrolytic type of ampere-hour meter possesses three points of great merit—cheapness, small drop of pressure and great permanent accuracy. Unlike motor meters, they require no compensation for frictional errors and no special breaks to correspond with the law of the driving torque. In fact, a properly designed electrolytic meter has a natural straight line of registration, and will integrate any current, however small, with perfect accuracy.

The paper then enters into a description of an electrolytic meter devised by Mr. Arthur Wright, and which has entered into use in British central stations. The principle of this meter is shown in Figs. 3 and 4 and illustrations of the two types as actually manufactured, are shown in Figs. 1 and 2, the latter instrument having combined with it a Wright maximum demand meter.

The general principle of the meter rests on the deposition of mercury from a solution of mercurous salt. The various parts of the electrolytic cell are enclosed in a hermetically sealed glass tube, and advantage is, of course, taken of the fluidity of the mercury to measure the volume deposited, instead of the weight. The total resistance (including the cell in the shunt circuit) is about 40 ohms, and the maximum current in it is about .025 ampere for a meter of 5-ampere capacity. The resistance in the main circuit is platinoid wire and has a value of .2 ohm.

That which differentiates this meter from those of similar type is the relative position of the anode *A* and the cathode *B*, the former being placed above the latter. The mercury of the anode is contained in a circular trough *C*, which is filled to such a height that the more concentrated solution formed by the electrolytic action falls off the convex surface of the mercury by gravity and thus automatically mixes the liquid and tends to keep it at a uniform density. The aid of gravity in thus promoting diffusion is secured by the employment of an anode feeder *D* after the manner of the well-known "bird fountain." When any portion of the mercury has been electrolyzed from the anode and the liquid sinks to the smallest extent, it is quickly restored to its normal height by a slight flow from the anode feeder, while a corresponding amount of solution replaces the mercury thus withdrawn from the feeder.

The cathode usually consists of a hollow cone of platinum carbon arranged concentric with the annular trough forming the anode. The circulation of the electrolyte is reinforced by the cathode, as the lighter liquid produced at its surface tends to rise and replace the

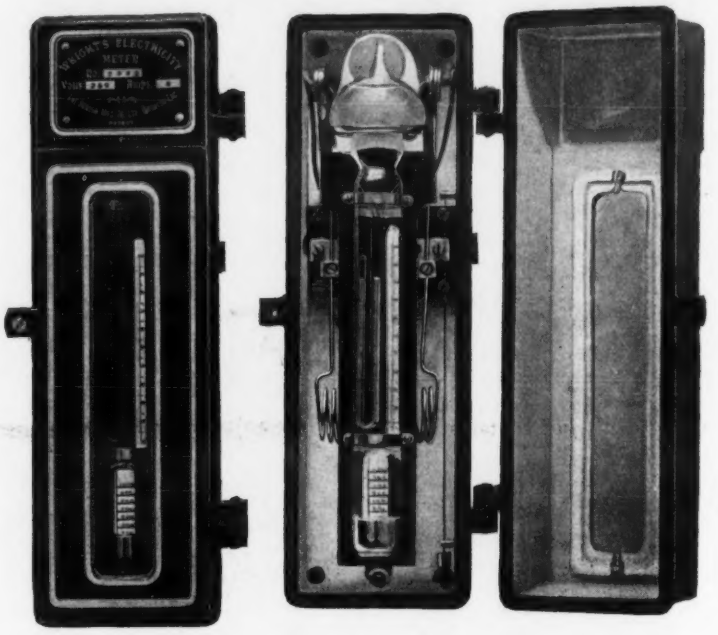


FIG. 1.—WRIGHT'S ELECTROLYTIC METER.

dense solution forming at the anode. This interchange of solution goes on continuously and there is thus no need for agitation and stirring. The large surface of the anode makes the internal resistance of the cell very small, and its symmetrical relation to the cathode makes the current density equal at each point and therefore minimizes any tendency to crystallize. The gravitational effect and the large extent of activity on the surface, permit of comparatively large currents in the cell before any signs of saturation of the solution become visible. As a result there is a large factor of safety between the working current density and that causing crystallization.

As it will be seen in Fig. 3, the meter is provided with two scales, the first of which is equal to 100 kw-hours and is fixed alongside one of the limbs of the siphon or U-tube *E* (Fig. 2). The mercury that is deposited on the platinum cone drops in this tube which opens out at its upper end into a glass funnel *F*, secured to the main tube so that none of the mercury can escape flowing into it and being measured.

When a quantity of mercury calibrated to be equal to 100 kw-hours has collected in the right-hand limb, it will stand at a level somewhat higher than the top bend of the siphon tube. This difference of level is sufficient to cause the siphon to come into action, and the whole of the mercury contained in the U-tube is drawn over and falls into the lower receptacle. This is graduated in such a manner that one division of a scale is equal to the complete volume of the U-tube, and thus acts like the second dial of a clock train counting mechan-

ism. A 5-ampere meter furnished with these two scales will conveniently register up to 1200 kw-hours.

When a full record has been obtained on the meter it is reset by tilting it up on its hinge terminals, when all the mercury in the lower part of the tube will flow back into the anode chamber. A small hole

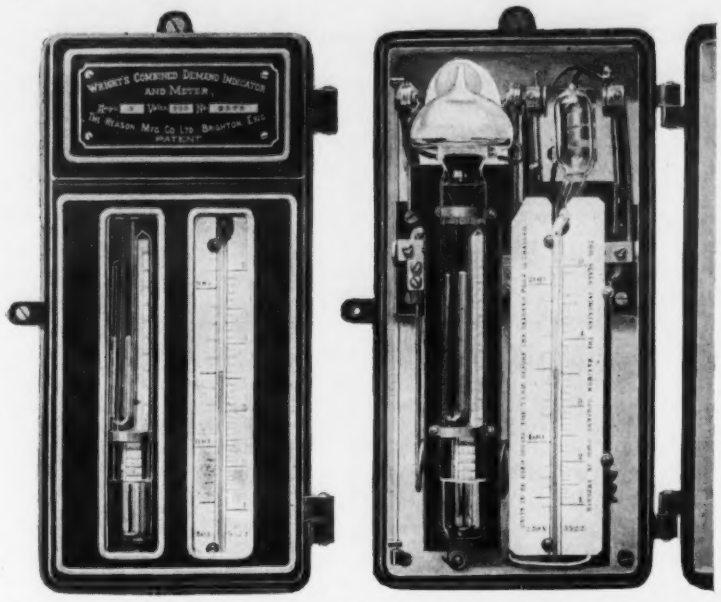
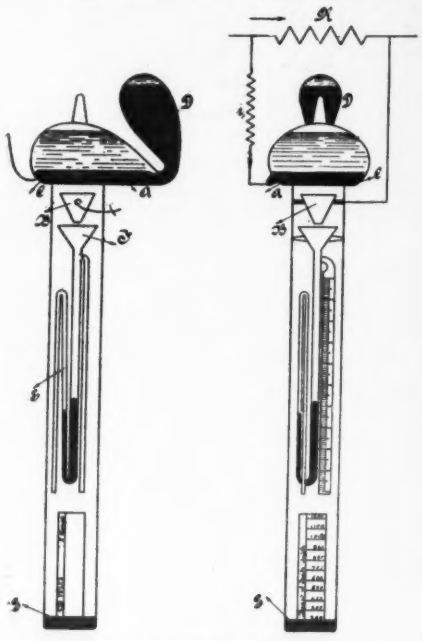


FIG. 2.—COMBINED WRIGHT ELECTROLYTIC AND MAXIMUM DEMAND METER.

is left in the glass funnel at the top of the siphon tube for the passage of the mercury. By this simple operation the meter is brought back exactly into its original condition and the cycle can recommence and be repeated indefinitely. This resetting is required only at long intervals. For example, in the case of a consumer with a 5-ampere demand on 230 volts, 1200 hours would represent at least 100 hours, all taken at the maximum load, or equivalent ordinarily to a year's consumption.

The paper above referred to gives a complete discussion of the principles of the meter and contains a number of curves compiled from data of tests, which indicate an extreme accuracy of registration. Fig. 4 shows the elec-



FIGS. 3 AND 4.—PRINCIPLE OF METER.

trolytic meter combined with a Wright maximum demand indicator in such a way that the heating resistance of the latter serves as a shunting resistance for the former, so that no further loss of pressure is entailed than with a single instrument. The paper also indicates how a single meter of this type may be used to a three-wire circuit as usually installed in houses.

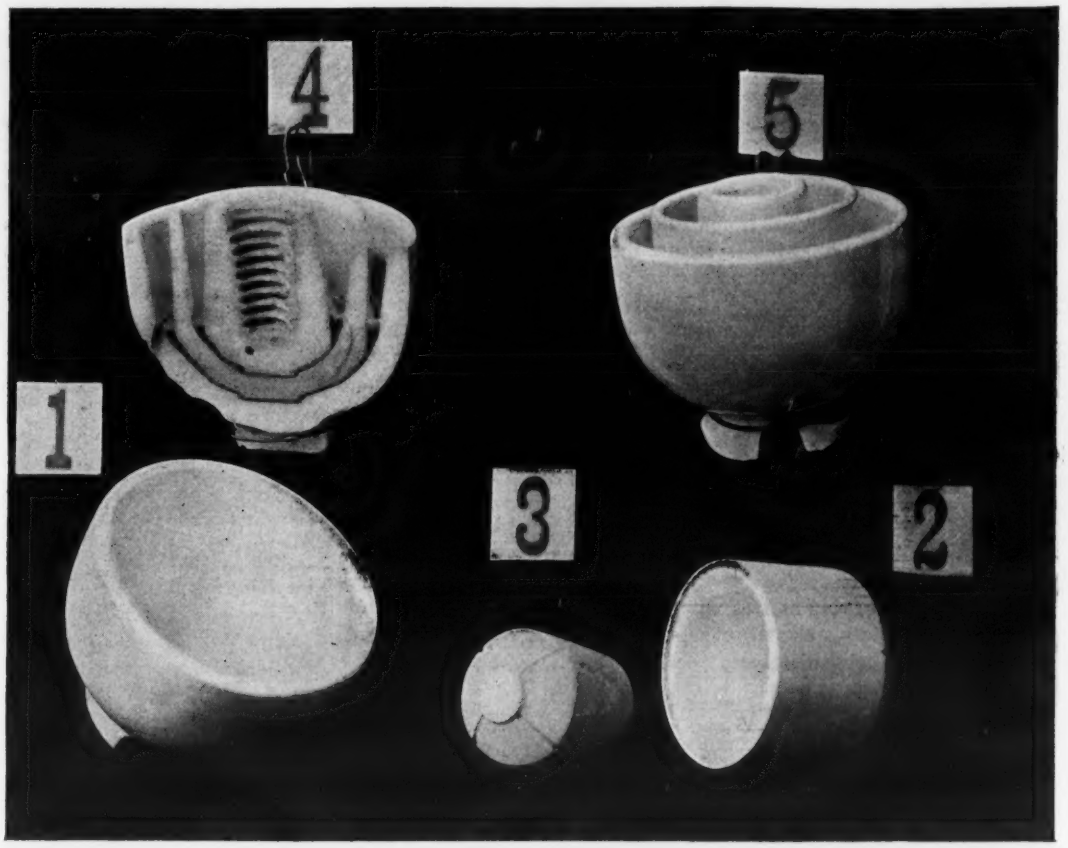
Boch's "Glaze-Filled" Insulator.

In the controversy between the advocates of porcelain and glass insulators for high tension transmission lines, it is conceded for porcelain that it has the advantage in respect to mechanical strength. The difficulty has been to make high voltage insulators of porcelain uniformly free from flaws. When that has been accomplished there can be little doubt that glass insulators can no longer claim superiority in insulating quality over porcelain ones.

R. Thomas & Sons' Company, of East Liverpool, Ohio, claim that their manager, Mr. J. W. Boch, has accomplished the task of producing a flawless porcelain insulator of superior insulating qualities as well as of great mechanical strength in his "glaze-filled" insulator. This insulator has gone into practical use during the past few years on high tension lines all over the country and has met with marked success. It is of interest therefore to know how this insulator is made, especially as Mr. Boch's patent has been recently sustained by the United States Circuit Court.

Mr. Boch's invention is primarily based upon the fact known ever since pottery was invented, that a thin piece of clay will mould and vitrify better than a thick one. For this reason Mr. Boch builds up his insulator out of two or more shells nested together. In the photo-engraving are shown separately at 1, 2 and 3, the three shells of which Mr. Boch makes up his triple petticoat insulator. The inner piece 3 is moulded with a suitable threaded socket (see Fig. 4) for the usual pin. The outer shell 1 is provided with the usual notched head for the conductor and like the intermediate part 2 is made bowl-shaped, so that the three are relatively thin shells, to be nested into each other.

In the practice usually followed by R. Thomas & Sons' Company, in making these insulators, these separately-molded parts are first dried out separately, preferably in an oven or kiln in the usual manner of drying clay articles by the process known as "biscuit firing." The separate parts are then coated with glaze all over, as by dipping into liquid glazing material, and they are then fitted into each other and



GLAZE-FILLED INSULATORS.

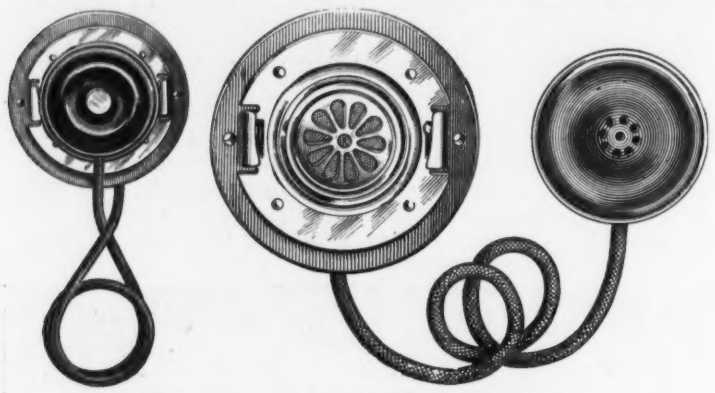
stood upside down, that is, petticoats uppermost, as in the position shown at 5. Extra glazing material is supplied at the joints, that is, in the annular channels between the petticoats.

The parts thus put together and supplied with extra glaze at the joints are now put in the sagger with the petticoats of the insulator uppermost and placed in a kiln, in which under great heat the clay

shrinks and becomes vitrified as usual and the glazing material melts and becomes of a glass-like character, flowing down into and filling all the spaces between the parts, such spaces either being there by lack of correct fit of the parts or arising during the shrinkage of the clay by the vitrification. The separately molded shells are thus welded together by seams of glass-like glaze, and this welding has been found to be of so tenacious a character that the insulators can be broken less easily along the lines of the "glaze-filled" seams than elsewhere. The completed insulator is shown at 5, while at 4 is shown one cut in two. This section clearly illustrates the three shells and the intermediate "glaze-fillings," which, needless to say, add to the electrical insulating qualities of the insulator as well as its mechanical strength.

A Push Button Telephone.

A novel invention has been recently placed upon the market by the American Push Button Telephone Company, of New York City, consisting of a complete telephone, including transmitter and receiver, which, in appearance and actuality, is not much larger than the ordinary electric push button. Fig. 1 shows the telephone when not in use. Fig. 2 shows the set with the receiver removed and exposing the transmitter. This telephone is an innovation that is worthy of notice. The compact size and neat appearance adapt it to interior work even where the decorations are of the finest, as the telephone



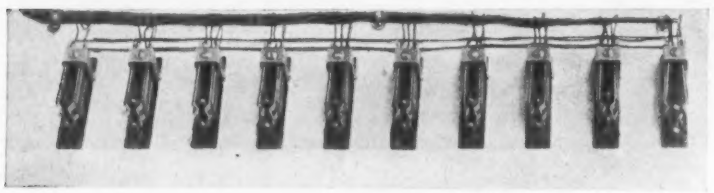
FIGS. 1 AND 2.—PUSH-BUTTON TELEPHONE.

sets are furnished in all woods from plain oak to mahognay and white enamel, and all metal parts are handsomely nickeled. While principally intended for interior work, either inter-communicating, switchboard, or two-on-a-line systems, the efficiency of this device has been proven by conversations carried on easily over 500 miles.

Where electric bells are already installed, the push button can be removed and the new instrument substituted in a few minutes without disturbing the existing wires, annunciators, bells or batteries. Each telephone is covered by a guarantee for one year. Wiring diagrams are furnished with each set of telephones.

Ringing and Listening Key.

Some of the principal difficulties encountered in making a small and compact switchboard circuit changer for large exchange and toll line boards, has been to provide springs of sufficient length to leave ample space for making and breaking the connections, and yet avoid breaking the springs; also to construct it so that the contacts and springs may be conveniently inspected when fully wired and con-



RINGING AND LISTENING KEY.

nected. With a view to avoid these difficulties and to devise one that would be electrically and mechanically right, the International Telephone Manufacturing Company, Chicago, have brought out their single cable, double mounted spring key.

The accompanying illustration shows ten of these keys mounted and wired. The set of ringing springs and the set of listening springs are mounted one above the other. The cam lever is forked, one leg operating the ringing springs from the front in the regular manner, the other leg passing through this set of springs and operating the listening springs from the rear. The springs are of heavy German silver and of ample length to allow a large space between the contacts and leave the cam easy to operate. They are provided with platinum contacts.

The springs are set into slots in the rubber insulating blocks and are firmly clamped with a brass plate securely held by a heavy binding screw. The springs pass through the insulating block and form terminals for wire connections. All the terminals are at one end. The wires for connecting the keys are made up in one cable. This arrangement leaves the contacts and springs free and open for convenient inspection. It is stated that this key is a great departure from the construction of those ordinarily in use in the past.

Lambert Schmidt Telephone Apparatus.

The Lambert Schmidt Telephone Manufacturing Company, New York, has now under way a 500-capacity multiple switchboard, common battery type, with lamp signals and telephones for the Manhattan Railway Company, New York City. The telephones are to be located at the stations and offices along the road. It is said that many

DESK TELEPHONE.

of the instruments will be placed fully ten miles from the exchange center and average 2000 calls per day. The board will be divided up into six operators' positions in order to carry this exceptionally heavy traffic.

The United States Army, through its Signal Corps, during the past two years has ordered a large quantity of telephones and several hundred switchboards, all being of a special portable army type. These instruments are in use throughout the fortifications in this country and in Porto Rico and the Philippines. Naturally in a hot and damp climate such as the Philippines, the apparatus is laboring under exceptionally severe conditions, but the Signal Corps has yet to make the first criticism against the service rendered.

In the interior line its automatic reset intercommunicating telephones are now being made for a capacity of 20 connections, and among the interior plants may be enumerated the Waldorf-Astoria, Majestic, Manhattan, Chelsea, Sherry's, University Club, New York Yacht Club, Union Club, etc. Among the latest apparatus of this company is an all-metal desk telephone set, shown herewith. It is provided with a special double-pole receiver, a new switchhook and a new form of adjustable transmitter. The stand is made with a heavy base to give stability and is finished in nickel plate.

An Independent Telephone System for Buffalo.

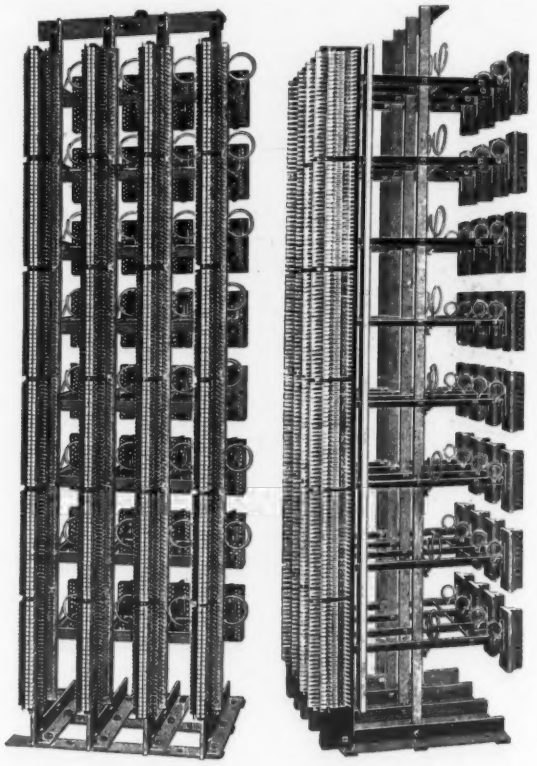
The Kellogg Switchboard & Supply Company has secured the contract for the switchboard from the Frontier Telephone Company, Buffalo, N. Y. This switchboard deserves particular attention, as the largest single multiple switchboard that has ever been built, it having a capacity of 18,000 lines. The Frontier Telephone Company was very strict in its requirements and demanded that the front of the switchboard must be so arranged that the distance from the key shelf to the top of the multiple jacks should not be higher than 35 inches, and that an operator must be able to have within easy reach 18,000 multiple jacks, besides 200 answering packs and lamps for herself and a sufficient number of outgoing and recording trunk lines. The only possible way of meeting these requirements was to put the jacks on 3/10″ centers. This will be the first jack of that size ever used in the world. The Kellogg Switchboard & Supply Company is particularly well equipped to make this installation a success, as its system requires only one spring in the jack and only two contacts in the plug. Hence, the 3/10″ jack can be built very substantially and have a higher insulation resistance than even a ⅜″ three-point jack.

The initial equipment is to consist of twelve sections, giving a present equipment of 4800 lines. In addition there is a large trunk equipment provided. The system is, of course, to be the very latest common battery relay system. The power plant will be complete in all respects, having a gas engine reserve so that there is no possibility of crippling the service. The desk equipment and all other apparatus pertaining to the exchange will also be as complete as it can be made and of the very latest design.

Combined Main Distributing Board and Office Protector.

The Sterling Electric Company has recently added to the apparatus of its manufacture a combined main distributing board and complete office protector, a view of which is shown herewith. The switchboard side of this distributing frame consists of complete protectors, heat coils and carbons in upright position, each strip having a capacity for 100, 150 or 200 pairs, usually in groups of 25 pairs each. The switchboard cable is brought to the protectors and formed and connected in the usual manner.

On the line side the line cables of any desired capacity are brought to the rear of the frame and laid up either horizontally or perpendicularly, passing through the line terminal blocks, then connecting with the terminal clips. The arrangement is such that the line side can be made in any proportion of increase over to the switchboard side without increasing the length already equipped on the switchboard side. This preserves a minimum length of jumper wires. The frame is entirely open on each side, giving easy access to all the cable and jumper wires. The horizontal openings across the back or line side are of such dimensions that jumper wires may be carried from one end of the board to the other at one movement without having to thread behind uprights, etc.



DISTRIBUTING BOARD AND PROTECTOR.

There is mounted back of each strip of protectors a maple guide block numbered to correspond with the numbering of the protectors directly in front of it. This facilitates the work and assures accuracy in the threading of the jumper wires, in making distributions. Each line terminal block is composed of a maple base with guide holes corresponding to each pair of terminal clips and made in any desired capacity, usually 25 pairs. The distributing rings are glass enameled and so placed that the jumper wires cannot draw across the corners of the iron frame. The framework is entirely of iron and of such cross section and so braced as to make it strong and rigid and being put together with bolts can be readily taken apart for packing and shipping and as readily set up for service. The frame is built for growth either to the right or to the left, as desired.

Improved Volt-Ammeters.

The accompanying cut represents a compact measuring instrument which is small enough to be carried in the pocket or tool bag and at the same time contains a high and a low reading voltmeter and an ammeter, so that it can be used for almost any desired measurement.

VOLT AMMETER.

The instrument shown by the illustration reads 0 to 4 volts in tenth-volt scale divisions and 0 to 20 volts in halves and 0 to 10 amperes in fourths, but other readings and combinations are furnished. Such an instrument can be used for a large variety of measurements, especially in telephone and similar work, where it may be necessary to test a single cell of battery as well as the pressure of the entire battery and also to measure the current flowing through some apparatus or circuit.

Another use of the instruments is to roughly determine resistances of from 2 to 1000 ohms or higher, according to the range of the instrument and battery used. For this purpose the resistance of the 4-volt circuit in the instrument is made 100 ohms and that of the 20-volt circuit 500 ohms; or 1000 ohms if the reading be 40 volts. These serve as standards for ascertaining the unknown resistance by the drop of potential method.

The instruments are of the permanent magnet type, with carefully aged magnets from special imported steel. Jewel bearings are used for the pivots of the moving parts, and the scales are made separately by hand from a correct standard. The construction is the same as that of a large portable instrument except the parts are smaller.

The size is twice that of the cut. This is large enough to secure accuracy and at the same time permits the instrument to be carried in the pocket. The instruments described are made by Mr. Louis M. Pignolet, of 76 Cortlandt Street, New York.

Lighting Lake Steamers.

The Northwest Steamship Company has been making rapid progress on the interior changes of its crack passenger boats "Northwest" and "Northland." These changes, although the steamers have only been in commission four years, include new boilers of the Scotch marine type, also many changes of the interior fittings. The estimated cost reaches nearly half a million dollars. Contracts for the most of this work have been awarded. On each boat there will be duplicate generating sets for electric lighting, consisting of two horizontal tandem compound engines made by the Buffalo Forge Company, direct connected to General Electric Company marine type 75-kw generators. The engines are specially designed for this contract, the space available being limited. As the boats are to be

put in commission at the near approach of lake navigation, the builders have agreed to deliver the engines in an extremely short time.

In addition to the above, these boats are being fitted out with a complete set of the most improved ventilating apparatus for maintaining the air in all portions of the vessel uniformly cool and pure at all times. Six Buffalo steel plate fans with direct-connected General Electric motors will be installed in each steamer with an elaborate network of galvanized iron ducts for delivering the air. This plant will be, when completed, in perfect accord with the remainder of the magnificent equipments of these splendid vessels.

Clark Telephone and Switchboards.

The accompanying illustrations show the latest type of desk telephone manufactured by the Clark Automatic Telephone Switchboard Company, and a 25-point switchboard. The telephone is particularly adapted for interior battery call systems and differs from other types

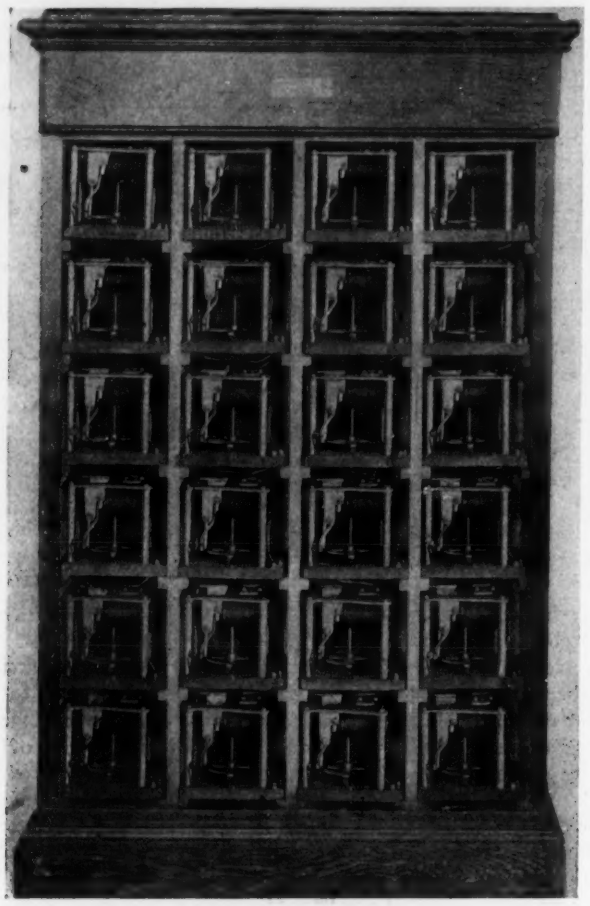


FIG. 1.—AUTOMATIC SWITCHBOARD.

made by the same company in having a push-button mounted on the side of the dial instrument, this arrangement having met with much favor.

The switchboard shown is extremely compact, requiring unusually

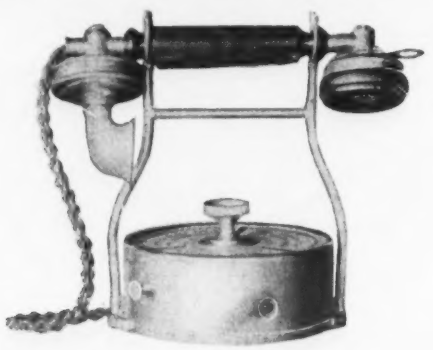


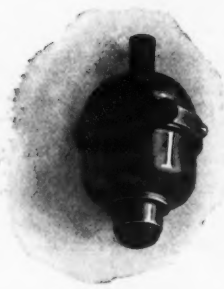
FIG. 2.—DESK SET.

small space for a board to handle a comparatively large interior system. Among the qualifications of the Clark system are its great flexibility. For example, when any person is away from his usual station he can arrange to be called in any part of the building where he may be at the time, and this can be changed as often as desired by the person himself without trouble or delay. Again, any station can make as many calls as required in quick succession, no time being lost in ringing off. With this system several different persons in different parts of a building can consult together with strict privacy of communication. The automatic feature has been particularly appreciated. One user, in a book of testimonials issued by the Clark

FIG. 3.—DESK SET.

Company, says that he finds the automatic feature especially useful and desirable at night or early in the morning when there is no one at the switchboard. In another testimonial it is stated that with the automatic switchboard, calls are made as early as 4 o'clock in the morning, and during Sunday when the works are closed.

Pendant Push-Button Switches.



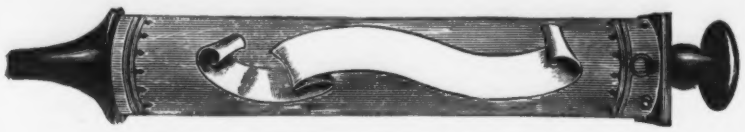
PUSH BUTTON SWITCH.

There are many uses to which pendant push-button switches are adapted for either temporary or permanent installations of incandescent lamps, multiple arc lamps or electric fans, while their small size and convenience of operation recommend them particularly for use in residences. They are quite generally used in connection with fan motors which, in such cases, may be placed in the most advantageous points regardless of accessibility. The General Electric Company's pendant push-button switches are made for 125-volt circuits of 5 and 10 amperes and for 250-volt circuits of 5 amperes. The terminals, contacts and working parts of the switches are mounted on a substantial porcelain base. The contacts for the switches are all of ample size for carrying the current required and so constructed as to withstand severe service.

The 250-volt switch is designed with two breaks in series and has knife-blade contacts. The contact surfaces are amply proportioned and the entire mechanism is substantial and thoroughly reliable. The switch is entirely enclosed by a polished brass casing which is fibre-lined and fitted with an insulating bushing at the opening for the lamp cord. The circuit is closed by pushing the rubber button which is attached to a metallic plunger inside the switch, and is snapped open by pressing the release button on the side of the switch. These buttons are threaded and screwed into their respective positions. The 5-ampere, 125-volt switch is 1⅝ inches in diameteer, the other two switches measuring 1⅞ inches in diameter.

Duster for Telephone Exchanges.

The Smith & Hemenway Company, of 296 Broadway, New York City, is introducing a cylinder dust bellows for use in printing offices, factories, machine shops, telephone or telegraph establishments, etc. This bellows has no metal mountings, thereby preventing short circuits while cleaning. For cleaning in awkward corners, pianos, organs, machine and all kinds of switchboards it is particularly useful. Any places that cannot be reached by a brush can be cleaned with a cylinder dust bellows. The compressed air forced in removes all



PNEUMATIC DUSTER.

particles of dust from such otherwise inaccessible places. The principal advantages of these bellows are the steady position of the point, on holding it between the fingers, the absence of metal mounting, and therefore no risk of injury to the articles to be cleaned; easy and comfortable manipulation, employment of force according to will; direction in any position; introduction to any space proportioned to the cylinder; and therefore the displacement of dust in inconvenient places without injuring the apparatus or articles to be cleaned.

Crocker-Wheeler Machines in a Telephone Exchange.

The Crocker-Wheeler Company as a manufacturer of dynamos and motors has entered the telephone field with a complete line of motor-dynamos and dynamotors. Until recently the need of such machines was small, but the centralization of energy has created a strong demand for them. To meet this, the company's engineers have given considerable study to the requirements of telephone work and as a result have placed on the market a line of motor-generators and

TELEPHONE MOTOR-DYNAMO.

dynamotors fully capable of complying with the needs of the modern exchange.

Among these is the battery charger, a natural outgrowth of the common battery idea. As a saving of expense and for maintaining a steady voltage, the storage battery possesses distinct advantages and is hence in very general use in central energy systems. It is seldom possible to have a commercial circuit supply charging current at proper pressure, and with practically every battery a charging outfit is necessary. To meet this demand the Crocker-Wheeler Company supplies a motor-dynamo or double field machine of any required output. The primary or motor side runs at either 115, 230, or 500 volts, the customary voltages of supply. The dynamo is wound to give whatever low voltage is best suited to the particular battery in question. The voltage is very easily regulated by control of the dynamo field, which may be of either shunt or compound winding and regulated with the ordinary field rheostat. The field is usually separately excited from the primary circuit. The accompanying illustration shows a motor-dynamo for this purpose, the motor being of 10-hp and driving a 8-kw generator. It will be noted that the machine is of compact form and graceful lines, while careful mechanical and electrical design may be assumed in machines of this source.

An objection sometimes made in the use of direct-current machines in common battery plants, is the humming caused by the brushes passing over the commutator. This is greatly reduced and almost done away with in Crocker-Wheeler machines, by the use of "noiseless coils" which utilize the magnetic inertia of the frame to smooth down the pulsations.

Closely following the battery charger in importance in a central energy exchange, is the current for ringing purposes commonly supplied by a ringer. The company manufactures these in a bi-polar type which, running at a speed of 1000 r. p. m., gives the proper ringing frequency to the alternating current of 1000 cycles per minute. They are all wound to give 75 volts, effective, on the secondary side, a standard adopted by the leading telephone companies.

This company also constructs machines combining these two services in one machine, which at times can be done conveniently. That is, in addition to the commutator on the secondary side which supplies charging current, collector rings are placed as well, which draw alternating current for ringer purposes. This is only occasionally done, for the secondary voltage must be of a certain rather high value in order to supply the proper alternating current for ringing.

A Swiveling Attachment Plug.

There have been many improved forms of electric fittings and appliances placed on the market during the past few years, but no one has seemed to think it worth while to improve attachment plugs. Owing to their great convenience, it has been necessary to use them, notwithstanding the fact that they have never been included in the list of approved fittings by the National Board of Fire Underwriters. Now, however, there has been invented and is being manufactured a swiveling attachment plug which is approved by the underwriters as safe as well as convenient. It is made all of porcelain, and the cord is attached to the cap in the same manner as in the old style plug; but there is no fuse, as none is now required. The top portion

FIG. 1.—SWIVELING ATTACHMENT PLUG.

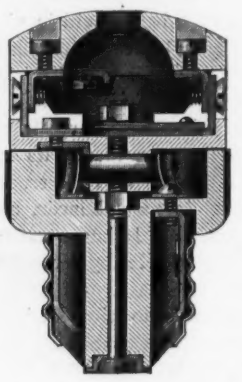


FIG. 2.—SECTIONAL VIEW OF INSIDE MECHANISM.

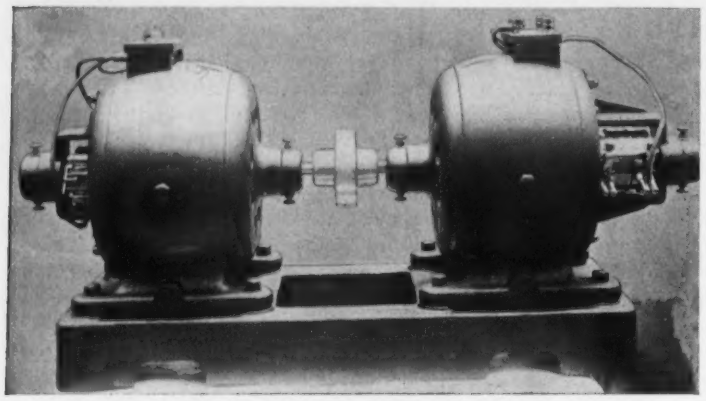
is held stationary so that the cord will not twist, while the lower portion is screwed into the lamp socket or receptacle by turning the corrugated porcelain part with the thumb and finger of the other hand. The difficulty and trouble arising from a twisted and tangled cord is thus avoided. Heavy lamp cord or show-window cord can be used, as there is ample space for it to be inserted and knotted.

The device is especially adapted for use with electric heating apparatus where heavy cord is generally used. It is also applicable for use with flexible armored conduit, with which, until the advent of this new plug, great difficulty has been experienced from the fact that the twisting of the conduit would result in untwisting of the plug and the opening of the circuit.

This new device is known as the Howes swiveling attachment plug, and is made by the Electric Gas Lighting Company, of Boston, Mass., who have been manufacturers of electrical appliances for the past twenty years. They will send prices and pamphlet upon request. The appliance will be on sale by all supply houses.

Combination Telephone Ringer.

We illustrate herewith a new combination recently gotten out by the Holtzer-Cabot Electric Company, Brookline, Mass., for ringing purposes in central stations, to operate in connection with a direct-current supply circuit. The apparatus delivers alternating and pulsating currents at about 80 volts and has an output of 250 watts. The pulsating current is used in party line signalling in connection with



COMBINATION TELEPHONE RINGER.

a bell constructed to respond only to the pulsating wave. The alternating current supply is used for signalling on the same circuits in connection with bells which respond only to the alternating current. The machine here illustrated is much larger than similar machines previously built by the same company, their extensive experience in this line of work having shown the desirability of machines of higher capacity than were formerly used.

New Kellogg Express Switchboard.

One of the latest types of switchboards made by the Kellogg Switchboard & Supply Company, of Chicago, is shown in the accompanying illustration. The front and rear panels are readily removable, being held in place by flush-ring catches of highly polished brass. This construction makes access to all apparatus a very simple matter. The key shelf is three-ply and hinged. The plug shelf is covered with heavy belt leather to prevent wear of the plugs. In designing this board, it was the purpose of the company to produce one that would, by its superior construction and utilization of the latest types of devices, overcome a number of objectional features found in most boards, and at the same time make it very rapid in operation. It has a capacity of 300 magneto lines, and is equipped with the Kellogg combined mechanically self-restoring drop and jack.

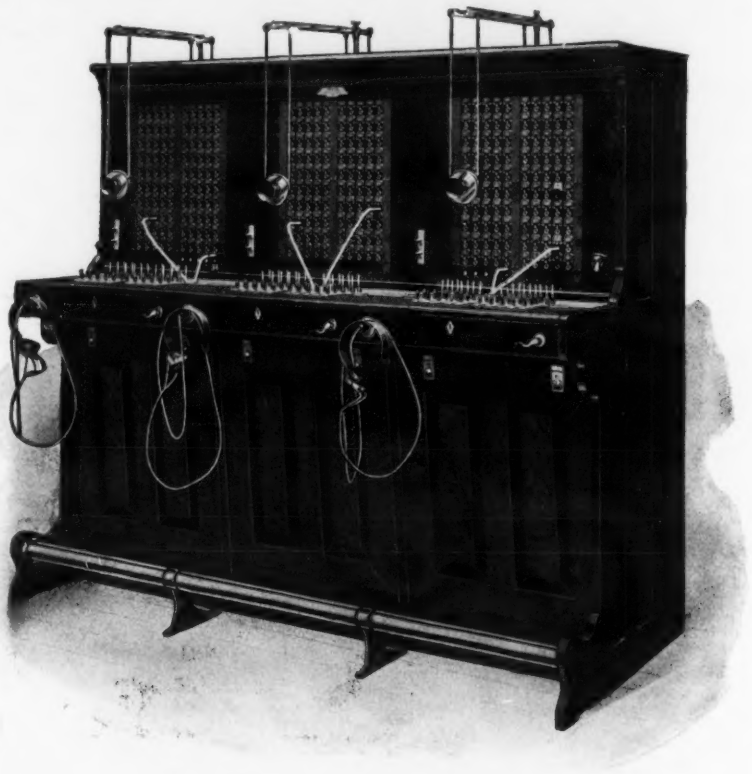
In each position is shown, just beneath the drops, the lamp transfers, five in number, with a capacity of ten in each position. These are operated by ten cells of Fuller battery. The object of these lamp transfers is to make rapid connections between subscribers whose lines terminate in positions not within easy reaching of the operator who receives the calls.

As an illustration, a subscriber asks the operator at the right for a number in the position on her extreme left; she immediately plugs into the transfer lamp, as shown in the illustration, which lights her lamp, and the corresponding lamp in the position where the connection is desired. This being a signal for the second operator, she immediately plugs into the jack corresponding to this lamp, as shown, which, being done, extinguishes both lamps, and completes the circuit between the two operators, thus enabling the first operator to give the second one the subscriber's number, who makes the desired connection. After the conversation has ended, the subscriber rings off, operating clearing-out drops in both positions, and then the operator pulls out both plugs. This operation illuminates the lamps in both positions, thus telling the first operator that the conversation has ended and the connection should be taken down, which, being done, both lamps are extinguished.

Each position is separated by a quartered-oak panel. A key is mounted on the two middle and left-hand end panels, which are so arranged that only one generator, either hand or power, can be connected in at any one time. The fourth switch, as shown on the extreme right, controls the night bell alarm, the object of which is to ring a bell whenever a drop falls, thus calling the attention of the operator.

The drops are of the tubular type, which gives a maximum of electrical and mechanical efficiency. The jack and drop are rigidly connected together by a metallic mounting strip, which makes their adjustment permanent. Any single drop or jack, or any part of one, can be readily removed from the board for repairs without the use of the soldering iron. The drop is cut out during conversation, presenting an absolutely free talking circuit. The jacks and drops are mounted five per strip, and fastened to a structural steel frame, with machine screws. The front and back are of polished hard rubber, reinforced by heavy brass, thus giving a neat appearance, combined with good insulation, and entire freedom from warping. The clearing-out drops are of the tubular type, high-wound and bridged across the cord-circuit. All the drops and jacks are mounted in a structural steel framework. The combined ringing and listening keys are very simple and well constructed. The springs are of German silver, with 99 per cent pure platinum contacts.

Each key is so arranged that the operator can ring out on either answering or connecting cord. The plugs and cords are the same as



EXPRESS SWITCHBOARD.

on large multiple boards. The plugs are reinforced by a steel-pointed tip. The board is wired on the full metallic plan, and is consequently readily adapted to common-return or grounded circuits. The operator's transmitter is the well-known Kellogg type, adapted for long-distance work, and is suspended from a nickel-plated arm, which has two adjustments, one for height, and one for distance from the board. The head telephone is provided with a 6-foot green silk cord, terminating in a plug, which may be inserted in the cut-in jack in the face of the keyboard. This cut-in jack is so arranged that when the operator's plug is withdrawn, the circuit of the operator's battery is automatically opened, as is also the operator's talking circuit. This prevents the wasting of the operator's battery when the board is not in use. The operator's hand generator is of the four-magnet type, and is mounted in the rear of the board, where it is readily accessible.

The cabling throughout the switchboard is done with silk and cotton insulated wire. All joints are soldered to their respective terminals without the use of any acid. All the line jacks and drops may be cabled down to a connecting rack at the bottom of the board and within the closing rear panels, or may be brought out direct in any length of cable, as desired.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered during the week with comparative freedom, but was not met with any particularly active demand. The closing rates were 4¼@4¾ per cent for 30 days to six months. In the stock market dullness prevailed throughout the week, due largely to the effect of higher money rates and the holidays. Heavy speculative liquidation was, however, lacking, and bear manipulation failed to unsettle prices to any extent. Better crop news and the favorable developments in the anthracite labor situation caused a rallying tendency and a somewhat bullish view of the market's immediate future. There was little activity in industrial specialties, and Amalgamated Copper was again alternately depressed and rallied. In the traction list, Brooklyn Rapid Transit closed at 64¾, a net loss of ⅞ point. Metropolitan Street Railway keeps about steady, closing at 167½. It fluctuated within narrow limits, the highest figure reached being 168½ and the lowest 167¼. The sales aggregated 9217 shares. General Electric continues its upward progress and reached 324¾ at one time during the week, the lowest figure being 319 and the closing price 322½, a net gain of 1½ points. Westinghouse Electric, common, closed at 193½, being a net loss of ½ point, and first preferred suffered a net loss of 1 point, closing at 197. Western Union made a net gain of ¼ point, closing at 90¼. A net gain of 2 points is recorded to the credit of American Telegraph & Cable, and an equal amount to American Telephone & Telegraph, the latter closing at 172 and the former at 87. Following are the closing quotations of April 1:

NEW YORK.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
American Tel. & Cable..	85	84	General Electric.....	322	321
American Dist. Tel.....	33	30	General Carriage.....	⅞	⅞
Brooklyn Rapid Transit..	65¼	63⅜	Hudson River Tel.....	—	—
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	167½	162½
Commercial Cable.....	148	148	N. E. Elec. Veh. Trans..	⅜	—
Electric Boat.....	25	24	N. Y. Elec. Veh. Trans...	12	12
Electric Boat pfd.....	47	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1½	1½	Tel & Tel. Co. America..	—	—
Electric Vehicle.....	2¾	2¾	Western Union Tel.....	89⅞	90¼
Electric Vehicle pfd.....	5	4¼	West. E. & M. Co.....	194	194
			West. E. & M. Co. pfd...	194	197

BOSTON.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
Am. Tel. & Tel.....	168½	173	Mexican Telephone.....	2½	2¼
Cumberland Telephone...	—	—	New England Teleph...	*146¾	146¾
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	100	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
American Railways.....	—	—	Phila. Traction.....	98	97½
Electric Storage Battery..	71½	76	Philadelphia Electric.....	5	4⅞
Elec. Storage Batt'y pfd..	73½	77	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7½	7⅝	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Mar. 25.	Apr. 1.		Mar. 25.	Apr. 1.
Central Union Telephone.	—	—	National Carbon pfd.....	91	90
Chicago Edison.....	175	175	Northwest Elev. com....	39⅛	39¼
Chicago City Ry.....	—	224½	Union Traction.....	19¾	18
Chicago Telep. Co.....	—	—	Union Traction pfd.....	56	—
National Carbon.....	25	24¾			

*Asked.

LOCKPORT POWER PROJECT.—As noted last week, the Lockport, N. Y., Common Council has awarded a contract to the Niagara, Lockport & Ontario Power Company to supply the city with pure water to be obtained from a power canal to be constructed from the Niagara River. The company must build the canal immediately, or forfeit the contract, which calls for an expenditure of $500,000 by the city for the water supply. This is much more than the water would be worth, but it is believed that the power canal would bring many great manufacturing concerns to Lockport. It will cost millions of dollars to dig the canal. William M. Luther, of Buffalo, who is financing the project, declares that $7,500,000 has already been subscribed in New York, Chicago, Philadelphia, Pittsburg, and Cincinnati. All that the capital invested in the project has been waiting for, he declares, is the contract with the city that was awarded this month. The power canal project would rival the Niagara Falls power project, as the company must develop at least 100,000 horse power in Lockport to make its contract operative. The citizens of Lockport pleaded with the Common Council to grant the application for the contract. The Niagara River will be tapped at Lasalle, and the water will be carried eighteen miles. The company must deposit $500,000 in a local bank within three months, the money to be used to begin the work of construction. The company has a franchise granted by the State, and the promoters are now securing options on land along the proposed route.

CONSOLIDATION IN BALTIMORE.—Advices from Baltimore, Md., state that a deal is about being completed between the Susquehanna Electric Power Company and the United Railways Company, which controls all the street railways and the lighting of that city. The contract is to cover the purchase of the United Electric Light & Power Company by the Susquehanna Company and the supplying of electric power to the United Railways. It is said in United Railways circles that the purchase price of the United Electric Light & Power Company will be $1,250,000 in cash. This will be paid to the United Railways for the $2,000,000 of common stock of the Electric Light & Power Company. Parties, however, connected with the Susquehanna Company said that the two companies would not be merged. The plans of the Susquehanna Company contemplate three developments of 40,000 horse power each on the Susquehanna River above Port Deposit. This power will be brought to Baltimore for distribution by the United Electric Light & Power Company. The Continental Trust Company, of Baltimore, has the financial plans in charge.

INTERNATIONAL NICKEL.—The International Nickel Company was incorporated last week at Trenton, N. J., with a capital stock of $24,000,000, half of which is to be common stock and half preferred, the latter bearing 6 per cent non-cumulative dividends. Former Attorney-General John W. Griggs is the private counsel of the new company, and the company's New Jersey agent is the Corporation Trust Company of Jersey City. The incorporators named in the certificate are H. P. Pell, Howard K. Wood and Kenneth K. McLaren. The company is authorized to deal in nickel and all other metals. This is the development of the plans of Colonel Robert M. Thompson, president of the Orford Copper Company; Charles M. Schwab, president of the United States Steel Corporation, and their friends, looking to the control of the mining of nickel ore. The new company will hold a controlling interest in the stocks of the Orford Copper Company of Bayonne, N. J., and the Canadian Copper Company, and an interest, which at last accounts was not a controlling interest, in the Nickel Corporation of London, England.

CONSOLIDATION OF COLUMBUS LIGHTING INTERESTS.—Articles of consolidation of the Columbus Edison Electric Light Company and the Columbus Electric Company have been filed. The new company, known as the Columbus Edison Company, has a capital stock of $1,000,000, $550,000 of which is preferred stock. Stock in the consolidated company is to be distributed as follows: For each $100 of Columbus Edison Electric Company $75 of preferred and $112.50 of common in the consolidated company. For each $100 of Columbus Electric Company $16.67 of preferred stock and $25 common stock in the consolidated. Officers of the new company are Adolph Theobold, president; John Siebert, vice-president; Arthur Field, secretary; Emil Kieseweter, treasurer. The list of directors includes nine directors of the Columbus Edison Electric Light Company and two of the Columbus Electric Company.

BRITISH THOMSON-HOUSTON.—The British Thomson-Houston Company, Limited, now controlled by the General Electric Company, has just floated on the London market, through J. S. Morgan & Company, £200,000 of 4½ per cent debentures for the purpose of partly defraying the expenditure incurred in connection with the company's new plant now being completed at Rugby, on which £240,000 is stated to have already been spent.

CHARLESTON, S. C., ANNUAL REPORT.—The Charleston Consolidated Railway, Gas & Electric Company reports for the fiscal year ended Feb. 28, 1902, as follows: Gross, $549,520, an increase of $61,997; operating expenses, $334,335; net, $215,185; charges and taxes, $153,437; balance, $61,748; new installations and sinking fund, $11,422; surplus, $50,326.

CINCINNATI GAS & ELECTRIC.—C. W. Wetmore and Geo. R. Sheldon have resigned as directors of the Cincinnati Gas & Electric Company, and their places have been filled by the election of Charles P. Taft and J. B. Foraker, Jr. The North American Company has parted with its entire holdings of Cincinnati Gas & Electric.

TOLEDO, OHIO, CONSOLIDATION.—The Philadelphia Guarantee & Trust Company is considering a proposition to purchase the Toledo Street car system, and several lighting companies for $14,000,000, and has an agent in Toledo at present making an inspection.

HOUSTON, TEX., ELECTRIC.—The annual report of the Houston, Tex., Electric Company for 1901 shows: Gross, $292,475; expenditures, $253,709; surplus, $39,046.

MONTGOMERY, ALA., TROLLEYS.—It is announced from Montgomery, Ala., that J. G. White & Company, of 29 Broadway, New York, have undertaken the building of a new street railway system in Montgomery. Colonel Barry Holt and other local men of wealth procured the franchises covering the ground not occupied by the existing system and extending over some ten miles of city streets. Colonel Holt is authority for the statement that White & Company have placed the bonds, ordered rails and cars and will begin work at once. The old system has refused to sell at less than $500,000. The new company will be at once organized, the syndicate owning the franchises, agreeing to take stock in exchange.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared a regular dividend of 1½ per cent, payable May 15. The directors of the Boston Suburban Consolidated Electric Companies have declared their first quarterly dividend of $1 per share. The City Railway of Dayton has declared the regular quarterly dividend of 1½ per cent upon the preferred and 1½ upon the common stock, payable April 1. The directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent, payable April 21.

UNITED POWER & TRANSPORTATION.—The United Power & Transportation Company, with headquarters in Philadelphia, announces that stockholders of record March 3 shall have the privilege of subscribing for stock of the company at $35 per share in the proportion of 15 per cent of respective holdings, the privilege to expire May 1. Fifty per cent of the amount due under the subscription shall be paid on or before May 1 on which interest will be paid at the rate of 4 per cent from the time of payment to July 1 and 50 per cent to be paid on or before July 1.

JACKSON, TENN., CONSOLIDATION.—An acceptance has been received, it is said, from St. Louis capitalists by which they will purchase the electric street car system, electric light and gas plants of Jackson, Tenn. The deal involves an outlay of about $200,000. The new company will extend the car system and make other improvements.

NORTH JERSEY TROLLEYS.—It is stated that within the next twelve months the North New Jersey Street Railway Company will spend $1,000,000 in improving its system. It has ordered 60 new cars and is arranging for a new power plant of 15,000-hp to cost $400,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The spring weather has favored retail distribution, which is reported as being very active East and West, with a fair business at the South. There has been on the whole less activity for iron and steel, but production and shipment have gone forward at undiminished speed. The building trades have taken a decided spurt in activity. Finished iron and steel has been active, implement and wagon manufacturers buying heavily of steel bars, which are nominally $2 per ton higher. The milder weather has somewhat relieved the strain on the coal trade, but strike talk has prevented weakness in prices. In the copper market there was some weakness and prices declined a fraction since last quotations. Very little business was transacted; consumers still show no disposition to enter the market. Lake is quoted at 12@12¼c., electrolytic and casting 12¼c., cathodes 11¼@11½c. and for casting stock 11½@11⅝c. The business failures for the week, as reported by *Bradstreet's*, aggregated 183, as against 197 the week previous, and 189 the same week last year.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended March 22: Antwerp—6 pkgs. material, $379; 4 pkgs. machinery, $250. Argentine Republic—41 pkgs. material, $387; 1 pkg. machinery, $213. British Guiana—52 pkgs. material, $2,412. Bremen—1 pkg. material, $15. British West Indies—15 pkgs. machinery, $386. British East Indies—13 pkgs. material, $1,017; 5 pkgs. machinery, $500. Brussels—2 pkgs. material, $184. Brazil—9 pkgs. material, $348. British Possessions in Africa—170 pkgs. material, $4,113; 46 pkgs. machinery, $2,221. Bristol—87 pkgs. machinery, $8,000; 1 pkg. material, $50. British Possessions (all others)—7 pkgs. material, $187. Copenhagen—1 pkg. machinery, $30. Central America—22 pkgs. material, $418. China—1 pkg. material, $100. Cuba—1 pkg. machinery, $14; 56 pkgs. material, $1,543; 40 pkgs. wire, $193. French West Indies—2 pkgs. material, $52. Glasgow—14 pkgs. material, $462. Hamburg—12 pkgs. machinery, $590; 14 pkgs. material, $910. Havre—16 pkgs. material, $220; 14 pkgs. material, $1,331. Hong Kong—17 pkgs. material, $417. Japan—80 pkgs. machinery, $3,641; 49 pkgs. material, $7,453. Korea—24 pkgs. material, $1,510. London—149 pkgs. machinery, $13,244; 73 pkgs. material, $5,585. Liverpool—455 pkgs. machinery, $13,817; 37 pkgs. material, $2,272; 140 pkgs. wire, $2,954. Leeds—12 pkgs. material, $239. Mexico—234 pkgs. material, $1,853; 9 pkgs. machinery, $4,429. Marseilles—21 pkgs. material, $315. Newfoundland—49 pkgs. material, $448. Nova Scotia—3 pkgs. machinery, $108. Philippines—21 pkgs. material, $628. Peru—8 pkgs. material, $437. Rotterdam—1 pkg. machinery, $45. Southampton—35 pkgs. machinery, $2,201. Swansea—913 bbls. copper material, $42,944. U. S. Colombia—58 pkgs. material, $544. Vienna—1 pkg. machinery, $45. Venezuela—116 pkgs. material, $2,300.

STROMBERG-CARLSON TELEPHONE.—In accordance with the news already given in these columns, the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, has now been incorporated in New York State, to take over the capital stock and assets of the Illinois corporation. The capital of the new concern is $3,000,000, and the directors are Alfred Stromberg, Andrew Carlson, Charles A. Brown, all of Chicago; Frederick Cook and Wallace B. Duffy, of Rochester. Mr. Eugene H. Satterlee, of Satterlee, Yeoman & Taylor, of Rochester, informs us that there is no intention of moving the plant to Rochester, but that it is possible an auxiliary plant will be located at that place for the purpose of making certain things which are used by the Stromberg-Carlson people, in order to relieve the great pressure on the capacity for production at the Chicago works. No change in the policy or in the practical operation of the company is contemplated. The new capital which has gone in has been furnished from Rochester.

SIMPLEX ELECTRICAL COMPANY, of Cambridgeport, Mass., has recently divided up among the men in its large factory for insulated wires and cables, a handsome bonus on a profit-sharing basis. The Mayor of the city presided at this very interesting function and Mr. Everett Morss, on behalf of the firm and family, in making an address said that the action was in no sense philanthropy, but a piece of business wisdom. The firm employs over 350 people, but the recipients were some 50, whose services had been continuous during the stipulated period of not less than two years. The amount divided up reached $3,000, and was entirely in addition to the regular wages, and of course the rate of pay, hours, etc., had all remained the same as though no profit-sharing plan had been inaugurated. The fifty men presented the Simplex Company with a handsome signed acknowledgement of the action of the corporation, whose business founded by Mr. Charles A. Morss, has become one of the notable industries of the place.

MR. J. H. VAIL, 1328 Chestnut Street, Philadelphia, announces that the Bonneville Portland Cement Works, Siegfried, Pa., has just finished installing under his specifications and supervision some important additions to its plant. An important feature of this installation is the use of motors for driving stone crushers, two large Gates crushers with bucket elevators made by the Link-Belt Engineering Company, being driven each by a 50-hp General Electric motor. The installation also includes an Armington & Sims 250-hp engine direct connected to a 150-kw Fort Wayne generator. In plants of this nature the depreciation is excessive, owing to the large amount of stone dust which is continually in the air. Mr. Vail has perfected a successful and efficient method of protecting the motors from this dust.

THE H. P. WHITE COMPANY, 1127 Appletree Street, is about to move its factory and main office to Wayne Junction, Philadelphia, opposite the Reading Railway station. It expects to be settled in its new quarters and ready for business by April 1. Its switchboard and switch business has grown so rapidly that for some time past its present quarters have been inadequate. The new factory will afford it ample facilities for turning out first class work with promptness and dispatch.

AUTOMATIC TELEPHONE ORDERS.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has among its recent export contracts one of 48 stations for the De Beers Explosive Works, Somerset West, Cape Colony, South Africa. This is another addition to an already large list of foreign orders and equipments. Among domestic orders, the company reports one from the Maine Insane Hospital, Augusta, Me., 60 stations.

STEAM TURBINES FOR ENGLAND.—The order for the plant for the Metropolitan Railway Company, Limited, to the British Westinghouse Electric Company will include three three-phase units of 3500-kw each, with 50 per cent overload capacity, two of the sets for steady use and one as standby. These are to be driven by Westinghouse-Parsons steam turbines. Three exciters are also included.

GREENFIELD, MASS., POWER TRANSMISSION.—The Greenfield Electric Light Company will develop a water power on the Deerfield River by building a dam and power house for 1500 horse power. The current will be transmitted five miles to the company's network in Greenfield. Mr. A. C. Rice, consulting hydraulic and mechanical engineer, State Mutual Building, Worcester, Mass, has the matter in hand.

ORDER FOR BOILERS.—Mr. J. S. Mitchell, secretary of the Weston, W. Va., Electric Light & Power Company, informs us that they have made a contract for two 125-hp water tube boilers with the Erie City Iron Works, of Erie, Pa.

AXLE CAR LIGHTING.—Mr. J. N. Abbott, vice-president and general manager of the Consolidated Railway Electric Lighting & Equipment Company, 100 Broadway, New York City, reports that after two years' crucial test, the Atchison and Pullman companies have accepted as entirely satisfactory the 115 "Axle Light" equipments used in Atchison service, and all private Pullman cars are now being equipped with the same electric car lighting system. They are also applying their lighting equipment extensively upon the cars of the Missouri Pacific, St. Louis & San Francisco, Chicago Great Western, Pennsylvania lines west of Pittsburg, Grand Trunk and other railways, as well as upon the private cars of many railway officials. The company either sells these equipments outright or installs and maintains them on a rental basis at no greater cost per car per annum than railway companies pay for gas, everything included. It would seem that the system and the method of introduction have great possibilities before them.

GILBERT WILKES & COMPANY, of Denver, Colo., report the sale of four carloads of Wagner transformers to the Denver Gas & Electric Company; one 40-hp Bullock teaser equipment to the Denver *Post*; two 20-hp Bullock motors to the Vulcan Iron Works, of Denver; one 10-hp, three 15-hp, and five 20-hp Wagner alternating current single-phase motors and three 40-kw, 60-cycle transformers, to the Idaho Springs Mining, Milling & Reduction Company, Idaho Springs; two 90-hp Bullock motors to the Denver Engineering Works; two 10-hp Wagner single-phase motors to the Billings, Mont., Water Works Company. The Denver Gas & Electric Company, which bought last September two 600-kw Bullock alternators, has now bought one 400-kw belted power generator, one 600-kw three-phase belted alternator and one 1500-kw, 60-cycle, three-phase direct connected alternator.

CROCKER-WHEELER TELEPHONE EQUIPMENT.—The battery chargers and ringers manufactured by the Crocker-Wheeler Company are meeting with success in the hands of the various telephone companies using them, and the demand is constantly increasing. Recent orders have been entered from the Bell Telephone Company of Buffalo, Pennsylvania Telephone Company of Harrisburg, Charlotte Telephone Company, American Telephone & Telegraph Company, New York & Pennsylvania Telephone & Telegraph Company, Iowa Telephone Company and the Pacific States Telephone & Telegraph Company. The Western Union and Postal Telegraph companies are also numbered among extensive buyers of Crocker-Wheeler dynamotors and motor-dynamos.

GASOLINE ENGINE PLANT.—Daboll & Crandall, civil engineers, 94 State Street, New London, Conn., are installing for the Groton, Conn., Electric Company a small village plant which will be operated under the same roof as the water pumping plant. They hope to run with water wheels a considerable portion of the year, and are putting in also a Westinghouse 80-hp gasoline engine for auxiliary power. As the water plant only requires power for a few hours each day, it is designed to use the same power for lighting at night. The plans are not quite complete, but the plant will probably start in with 150 incandescent street lights and 1000 commercials. Mr. H. W. Hobbs, of the Hawks Electric Company, Boston, is the electrical engineer of the plant.

STANDARD ELECTRIC COMPANY.—The Standard Electric Company, of Erie, Pa., has recently been organized for the purpose of manufacturing electric machinery for all purposes, and also to do a general repair business. Carson J. Sturgeon, Wm. Tozer and W. J. Ferguson are the interested parties and are practical men in this line of work. They are prepared to bid on electric motors and dynamos for delivery in quick time. They have a line of patterns covering all sizes up to 50 horse power and are in position to bid on work at once.

EQUIPMENT FOR HARTFORD STREET RAILWAY PLANT.—Westinghouse, Church, Kerr & Company, of 26 Cortlandt Street, New York City, have been awarded a contract by the Hartford Street Railway Company, of Hartford, Conn., for a 1600-hp Westinghouse Cross Compound Corliss engine and a Westinghouse street railway generator, having a capacity of 105 kw. This equipment is intended to be installed in the Hartford concern's enlarged plant, now under construction.

A NEW TRANSMISSION PLANT.—The Sacramento Electric, Gas & Railway Company has purchased reservoir sites and acquired water rights for an additional electric power transmission. The site will be on one of the branches of the American River about 40 miles above the company's Folsom Power station. The distance of transmission to Sacramento via Folsom will be about 60 miles. It is estimated that 10,000 hp can be developed with an available head of 1700 ft.

EUROPEAN RAILS FOR MEXICAN TRAMWAYS.—The Mexico Electric Tramways Company, of the City of Mexico, whose entire purchases for equipment, etc., have hitherto been made in the United States, is about to place a contract for 700 tons of rails in Europe because of the better inducements being made by competitors on the other side. The rails are to be of 90-lb. weight and are intended to be used for an extension of the company's system.

POLICE TELEGRAPH SUPPLIES.—Commissioner Partridge, of the New York Police Department, has made a requisition for $170,000 for extra telephone and telegraph supplies. It is a notorious fact that the signaling systems of both the police and the fire alarm services in Greater New York need a lot of money spent upon them to bring them up to modern ideas of efficiency and to make them equal to the demands of the rapidly increasing population.

SHAW CRANE FOR SAN FRANCISCO PLANT.—The Shaw Electric Crane Company, of Muskegon, Mich., whose New York offices are at 85 Liberty Street, has obtained a crane contract for the new Market street power station at San Francisco. The crane will have a capacity of 30 tons and is to be equipped with a three-ton auxiliary hoist. The span will be 47 feet. The equipment is to be operated by three motors having an aggregate of 55 hp.

THE WINTON MOTOR CARRIAGE COMPANY, Cleveland, is having plans prepared for what it claims will be the largest automobile factory in the world. A twelve acre site adjoining the National Carbon Company's plant has been secured, and the main building will be nearly 900 feet in length. Gasoline engines will furnish the power. A large lighting plant will be installed.

MORE MACHINE TOOLS FOR JAPANESE ARSENAL.—The Garvin Machine Company, whose establishment is at Spring and Varick Streets, New York City, has secured a machine tool order through the Japanese house of Takata & Company, of 10 Wall Street. The equipment is intended to be installed in the new Japanese Government arsenal about to be built at Maizura.

DAYTON-CINCINNATI TROLLEY.—Dr. Samuel F. George, president of the Dayton, Fort Wayne & Cincinnati electric line, claims to have negotiated all the bonds of the company, and financed the building of the road in New York City. The road will be rapidly pushed towards completion; J. G. White & Company will construct and the General Electric Company equip the road.

SUB-STATION EQUIPMENT FOR CALIFORNIA.—The General Electric Company will supply the Los Angeles and Redondo Railway Company with the equipment for three substations. There will be eight motor-generator sets, besides transformers, switchboards, etc. Electric power will be taken from one of the Southern California transmission lines.

THE ST. LOUIS FAIR.—All the electric wires on the World's Fair grounds will be carried in a subway, the contract for which was to have been let by the Director of Works April 1. The subway must be finished by June 1, 1902, and a penalty of $100 per day is imposed for delay. Details of the subway have already appeared in these pages.

BRILL EQUIPMENT FOR ENGLAND.—The J. G. Brill Company, of Philadelphia, is about to make shipment of 42 truck frames, etc., to Bournemouth, one of the principal seaside resorts on the south coast of England, the electric traction system of which place will be largely installed with American equipment, etc.

BALL ENGINE ORDERS.—The Pacific Coast Oil Company, Point Richmond, Calif., has purchased an engine for electric service from the Ball Engine Company, Erie, Pa. The Casper Electric Company, Casper, Wyo., is installing for driving a dynamo, an engine purchased from the Ball Engine Company.

PUSH-BUTTON TELEPHONES.—The American Push-Button Telephone Company, of New York City, reports a great demand for its device and has received orders in March for over 9500 telephones. The neatness and the handiness of the apparatus are creating considerable popularity for it.

THE ROSSITER-MAC GOVERN ELECTRICAL COMPANY has filed articles of incorporation in St. Louis, Mo. The capital is $5,000, the incorporators being Clinton L. Rossiter, Frank MacGovern, Arthur B. Shepley, Thos. K. Skinker and Charles R. Skinker.

LIGHTING PLANT WANTED.—A lighting plant will be required for the shops to be erected at Upper Sandusky, Ohio, for the Marion Machine & Tool Company, formerly of Marion, Ind.

EXPORTS FROM SAN FRANCISCO.—The exports of electrical materials and apparatus from the port of San Francisco for the month of February reached a valuation of $5,796.

PROPOSALS will be received at New Baltimore, Mich., until April 12 on an electric lighting plant, including generator, engine, switchboard, transformers and lamps for the new city plant.

PRATT & WHITNEY COMPANY, Hartford, Conn., will erect a new small tool department, doubling its capacity, and to be operated by electric motors.

MACHINERY EXPORT TRADE, ETC.—The following table shows the exports of principal articles of iron and steel manufactures in the seven months ending with January, 1902, compared with the corresponding months of the preceding fiscal year:

Articles.	1901	Seven months ending with January, 1902.
Pig iron (tons)	232,606	45,158
Bar iron (lbs.)	31,326,242	13,682,477
Bars or rods of steel (lbs.)	166,834,554	38,571,104
Hoop and scroll iron (lbs.)	6,584,268	2,296,574
Billets, ingots, etc. (tons)	108,619	2,249
Steel rails (tons)	199,122	132,539
Sheets and plates (lbs.)	85,514,687	18,489,620
Wire (lbs.)	88,380,282	123,137,826
Builders' hardware	$5,384,402	$5,152,714
Electrical machinery	$3,211,179	$2,963,696
Metal-working machinery	$2,789,524	$1,786,998
Pumps and pumping machinery	$1,343,116	$1,243,006
Sewing machines	$2,521,255	$2,201,165
Locomotive engines, (No.)	223	201
Typewriters	$1,568,209	$1,751,789
Nails and spikes (lbs.)	42,204,550	22,739,434
Total value of exports	$73,616,467	$57,310,128

It appears from investigation and reports that manufacturers in general have experienced no falling off in foreign orders, but have been hindered from meeting them by the heavy demands of the home market.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, Ill., reports having recently closed a contract with the Rawson Electric Company, of Albany, N. Y., for one of its latest central energy multiple switchboards consisting of six sections, with an ultimate capacity of 6000 lines. Its present equipment will consist of 2100 lines. Included in this contract is one toll board consisting of one 2-position section, also all necessary power apparatus, arrester and distributing frames and relay racks, etc. Another contract has been closed with this company for one of the Kellogg latest type central energy multiple switchboards consisting of three sections with an ultimate capacity of 4800 lines. Its present equipment will consist of 960 lines. Included in the contract is necessary power apparatus, arrester and distributing frames and relay racks, also a 2-position section toll board. The Kellogg Switchboard & Supply Company also reports having closed a contract with the Rawson Electric Company, of Cohoes, N. Y., for one of its latest type central energy multiple switchboards of 2400 lines capacity. Its present capacity will consist of 800 lines. Included in this contract is a toll board, all necessary power apparatus, distributing frames, relay racks, arrester frames, etc., all of which will be furnished by the Kellogg Company.

TO EXTEND TRANSMISSION LINES.—The Northern California Power Company has been incorporated by Antoine Borel, James Coffin, Edward Coleman, E. E. Shotwell and H. H. Noble, with a capital stock of $2,000,000. Among its purposes are to absorb the Keswick Electric Light & Power Company, of which H. H. Noble is president, and provide for a bond issue of $2,000,000. The funds realized from the sale of the bonds will be devoted to enlarging the capacity of the Keswick Company's hydro-electric transmission plant, near Shingletown, Shasta County, and extending the system considerably. The Tehama Electric Light & Power Company, of Red Bluff, has been purchased and its plant utilized as a sub-station. The transmission lines will be extended farther down the Sacramento Valley. The Keswick transmission plant has an electric development of 3000 horse power and a water power development of 4500 horse power, there being 3 water wheels, each of 1500 horse power. At this site 12,000 horse power can be developed and there are additional sites available.

TROLLEY WIRE FOR SYDNEY, N. S. W.—The National Conduit & Cable Company, Times Building, Park Row, New York, have secured a contract, valued at nearly $100,000, for trolley wire, to be used in the construction of the Sydney City & Suburban electric traction system, Australia. The contract was obtained through R. W. Cameron & Company, of 23 South William Street, New York. As already mentioned in these columns, the initial equipment for the Sydney power station, representing an expenditure of some $800,000, was allotted to the General Electric Company, and it is proposed to extend the station shortly, at an estimated cost, with equipment, of about $500,000. It may be well to state that the tenders now being invited by the municipal Council of Sydney for the equipment, etc., of electricity supply works have no reference to further contracts for the Sydney electric traction system which is being built by the New South Wales Government Railway and Tramway Commissioners, and not by the municipality of that Australian city.

SHEDD OSCILLATING FANS ABROAD.—The Shedd Electric & Manufacturing Company, of 136 Liberty Street, New York City, reports having entered into arrangements with Drake & Gorham, electrical engineers, of 66 Victoria Street, London, S. W., for the representation of their interests in Great Britain for a period of one year. It has lately been in receipt of a large number of orders and inquiries from abroad, and is afraid it has already struck the limit of its producing ability for the season of 1902. The company has given to Mr. J. Frank Eline, of Baltimore, Md., the sole agency in that city for the "Comfort" oscillating fan, which was recently described and illustrated in these pages. The Federal Electric Company, whose offices are in the Washington Life Building, 141 Liberty Street, has recently ordered over 100 Shedd fans for shipment to various Mexican and South American points.

ELECTRICAL EQUIPMENT FOR JAPANESE COLLIERY.—The Hokkaido Colliery & Railway Company, of Hokkaido, Japan, is to be furnished with some $30,000 worth of American electrical equipment, etc., for mining purposes. The principal item appearing in the contract calls for two compound condensing engines of 400-hp capacity each, which will be built by McIntosh, Seymour & Company, of Auburn, N. Y. The generators, it is reported, will be of English manufacture. The J. R. Van Dyck Company, Electrical Exchange Building, New York, has been allotted an order for the oil filtering apparatus. The filters will be made by the Pittsburg Gage & Supply Company. These contracts were secured through H. Becker & Company, of 35 South William Street, New York, which concern succeeded to the business of Heyn, Brockelmann & Company, of Japan.

LARGE POWER PLANT ORDER.—It is stated that important contracts for a power plant, to cost $500,000, have been given out by the Pittsburg, McKeesport & Connellsville Electric Railway, to be built at New Haven, Pa. The Westinghouse Electric & Manufacturing Company will furnish three generators, each of 1850-hp capacity. The pumping and condensing plant, with a capacity of 6,000,000 gallons daily, will be installed by Henry R. Worthington, of New York. There will be three vertical Allis engines installed by the Allis-Chalmers Company, of Milwaukee, Wis. The boiler plant will consist of two batteries, each containing six boilers with a total steam generating capacity of 6000 horse power. In addition to the coal and ash handling machinery, there will also be a 30-ton electric crane for handling heavy machinery.

WESTERN ELECTRIC FACTORIES.—An addition to the Chicago factory facilities of the Western Electric Company is announced. The concern is arranging for the erection of three additional buildings upon the property at Polk Street and the river. One of these buildings will be occupied by the wood working department for telephone boxes. The building will be three stories, 96x157 feet, entirely of fireproof material. The second building will be used for shipping purposes, will have a floor area of 8400 square feet, and a third will contain the machinery for wire stranding and will cover an area of 12,000 square feet.

BIG ASTOR HOTEL PLANT.—The Astor Hotel to be built at Fifty-third Street and Fifth Avenue is to be equipped for general light and power purposes with a 1500-hp plant. The engines will be manufactured by the Harrisburg Foundry and Machine Works, while the generators are to be built by the Western Electric Company. There are to be two engines of 450-hp each, direct connected to two 300-kw generators and the same number of 300-hp each, direct connected to 200-kw generators.

INCANDESCENT LAMP CONTRACT.—The contract for supplying the eleemosynary institutions and other State buildings of Texas with 10,000 incandescent electric lamps has been awarded to Teagarden & Schumate, electric supply dealers of Austin, Tex. Their bids were: Highest grade Columbia incandescent lamps, guaranteed one hundred hours, 4 to 25 candle-power, 16 cents each; 8 to 16 candle-power, 18 cents each, and 32 candle-power, 25 cents each.

THE WELLMAN-SEAVER ENGINEERING COMPANY, of Cleveland, has changed its name to the Wellman-Seaver-Morgan Engineering Company, and has enlarged its scope to include the manufacture of machinery of all kinds and other iron and steel products. Rapid progress is being made in the company's large plant in Cleveland and a portion of it is now in operation.

LARGE ORDER FOR CASTINGS.—The Craig Shipbuilding Company, of Toledo, has received a very large order for special castings from the Westinghouse Electric & Manufacturing Company, to be supplied at the rate of twenty tons per day.

NEW POWER PLANT.—The Cleveland, Frog & Crossing Company, Cleveland, Ohio, is making important additions to its plant and is preparing to erect a new power plant.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The State is constructing a telephone line to connect the penitentiary at Wetumpka with the State farms at Speigners. The line will be 25 miles in length.

TUSCALOOSA, ALA.—The Southern Bell Telephone Company has purchased the Tuscaloosa Telephone Company's system and will hereafter operate it as part of its own.

ALMA, ARK.—The Alma Telephone Company has been organized, with a capital of $2,500. Mr. Jacob Yoes is president, W. C. Yoes secretary and James J. Yoes treasurer.

FORT SMITH, ARK.—The Choctaw Telephone Company has completed its line from Denison to South McAlester, and will now build to Bokchito, east of Caddo, and parallel the line of the Arkansas and Choctaw to the Kansas City Southern and then north to Fort Smith.

TEXARKANA, ARK.—The Texarkana Telephone Company, of Texarkana, capital stock $150,000, has been incorporated for the purpose of constructing and operating telephone exchanges and telephone toll lines in the States of Texas, Louisiana and Arkansas. Incorporators: F. M. Mamott, of Delaware, Ohio; W. P. Harrison and Fred. E. Harrison, of Cincinnati, Ohio; P. J. Eubanks, of Columbus, Ohio; B. M. Kuhl, Hiram Glass and J. Huckins, of Texarkana, Ark.

SAN FRANCISCO, CALIF.—A local telephone company has been organized in Pomona, Calif., with John Law, D. W. Parker and F. L. Palmer as directors.

AUBURN, GA.—The Auburn Telephone Company has been incorporated, with a capital stock of $400, by T. O. Hein and others.

HARRODSBURG, GA.—The Mercer Telephone & Telegraph Company is being organized for the purpose of establishing a system here. Among those interested are L. H. Carter, of Lawrenceburg, and Philip Ponge, of Louisville, Ky.

LINCOLNTON, GA.—Messrs. C. L. Groves and Reid Nash, of Lincolnton, will construct a telephone line between Lincolnton and Washington, Ga.

ATWOOD, ILL.—Atwood Mutual Telephone Company, capital $4,000, has been incorporated by A. V. Pounds, W. E. Means and C. B. Moore.

BENSON, ILL.—The Benson Telephone Company, capital, $10,000, has been incorporated by S. L. Peterson, J. E. Eckhart and R. Parks.

CHICAGO, ILL.—The law firm of Blum & Blum has commenced injunction proceedings in a Chicago court against the Chicago Telephone Company, declaring that the charging of more than $125 a year, the franchise rate, is illegal and against public policy.

CHICAGO, ILL.—The Talbot-Frost Telephone Company has been incorporated at Dixon, with a capital stock of $2,500. The incorporators are J. O. Fouts, C. B. Root and A. L. Cruzen.

CURTIS, ILL.—A new telephone line is being built between Sweetwater and Greenview. Several of the intervening farmers are having private lines put up.

HOOPESTON, ILL.—The Hoopeston City Council granted a new telephone franchise to J. E. Whitman.

ONARGA, ILL.—The Onarga telephone exchange is now in a fair way to become the largest in the county. There are already 182 instruments, and there are to be added six more farmer lines with 39 instruments, and about one dozen more in this town, which will swell the total to 232.

TOULON, ILL.—The Toulon Mutual Telephone Company has been incorporated with a capital of $500. The incorporators are Frank Berfield, Emery S. Buffum and George E. Sadler.

VIENNA, ILL.—Vienna Mutual Telephone Company, capital $2,500, has been incorporated by James H. Carter, W. S. Crum and Charles H. Gray.

ALEXANDRIA, IND.—The Delaware & Madison Telegraph and Telephone Company has been given a thirty-three year franchise by the Alexandria City Council.

EUREKA, IND.—The Luce & Ohio Township Telephone Company has increased its capital stock from $10,000 to $50,000.

FLORA, IND.—About one hundred local business men and neighboring farmers have organized the Farmers' Mutual Telephone Company, with a capital stock of $25,000.

FT. WAYNE, IND.—The Indiana Electrical Investment Company, of this city, gave a banquet recently to the Logansport Telephone Company stockholders and the Cass County Construction Company, to celebrate the completion of the independent telephone system at Logansport, which already operates 950 telephones. The same company is constructing the new telephone system at South Bend.

INDIANAPOLIS, IND.—The Citizens' Mutual Telephone Company has been incorporated, with a capital stock of $200. It will erect and operate a telephone exchange in the town of Newport. The directors are C. P. Potts, H. V. Nixon, E. B. Huxford, J. A. Hughes and B. H. Davis.

INDIANAPOLIS, IND.—Two telephone companies filed articles of incorporation during the past week. The Big Lick Telephone Company, of Madison County, capital stock, $2,000. The directors are George Boram, James Cunningham, John Bennett and John Brock. The company will build farmers' lines in Madison County. The Whitesville Co-operative Telephone Company, of Whitesville, capital, $1,000; directors, D. H. Davidson, S. W. Gorley, J. A. Landus, A. L. Byers and G. W. Conn. The company will construct an exchange at Whitesville and build lines into the country districts.

INDIANAPOLIS, IND.—The Central Union Telephone Company has done away with the four-party-line lock-out service in the business districts at $40 a year, but the company makes a four-party non-lock-out contract at $2.50 a month, or $30 a year. The merchants complain of the change and regard it as a scheme to raise the rates. The company has also refused to issue any more $10-toll books for $7.50 for toll line service on long-distance lines. These books gave merchants a 25-per-cent reduction. The company is now making a four-party-line service contract in the residence district at $1.50 a month.

LAFAYETTE, IND.—The merchants of this city are taking steps to secure free telephone service with towns, cities and farmers throughout the county. They claim that Frankfort and Crawfordsville, cities of adjacent counties, are extending free service into Tippecanoe County to the detriment of Lafayette merchants. They ask that the Lafayette Telephone Company co-operate with the People's Co-operative Company, which is now operating in the county, and with other companies so as to give free service. If not willing to do this, then the Council will grant a franchise to a company that will.

NEW ALBANY, IND.—An exchange will be established by the Cumberland Telephone Company at Georgetown, this county, and the subscribers, over one hundred in number, will have the use of all the lines to every part of the county.

NEWCASTLE, IND.—R. R. Faulkner has purchased the franchise, equipment, etc., of the Newcastle Telephone Company.

RISING SUN, IND.—The Ohio River Telephone Company, capital $45,000, has been incorporated to operate in Dearborn, Ohio, Switzerland, Jefferson and Ripley counties. The incorporators are William M. Green and Calvin R. Green, of Rising Sun, and William M. Green, jr., of Vevay.

BRADGATE, IA.—The Humboldt County Telephone Company, capital $10,000, has been incorporated by W. S. King, George Fletcher, S. F. Boyden, M. A. McCray, W. C. Hoag, Jerome Tilton, W. O. Brown, George E. Kelsey, George V. Jarvis, F. M. Lee, Clark Brown, J. V. Overholser and W. S. Wallace.

BUFFALO, IA.—The Rural Telephone Company will construct a line from Linwood to Buffalo.

CEDAR RAPIDS, IA.—The Cedar Rapids & Marion Telephone Company has filed an acceptance of the ordinance passed by the Council extending and enlarging the franchise.

CLOUD, IA.—A company has been organized to build a telephone line connecting Newbern with Knoxville.

COLLETT, IA.—A telephone line is to be built from Birmingham via Collett to Libertyville.

COLLINS, IA.—The Collins Telephone Company, capital stock, $10,000, has been incorporated.

DES MOINES, IA.—At the close of March the Mutual Telephone Company issued a report showing a net increase in the number of subscribers of about 170. During January there were 46 new telephones put in, in February 57, and orders now on file make the total 166 subscribers in three months, or an average of 600 a year. The Mutual now has 2,100 subscribers. The Mutual Telephone Company has placed an order for several thousand feet of new cable to be used in the construction of an extended underground conduit system.

GRINNELL, IA.—The Long Distance Cipher Telephone Company, capital stock $500,000, has been incorporated by C. B. Morse, C. W. H. Beyer and C. H. Brown.

IOWA CITY, IA.—The Pleasant Valley Telephone Company will build a line to Lone Tree.

JOHNSONVILLE, IA.—It is reported that the Farmers' Mutual Telephone Company will extend its line south to Johnsonville.

MEDIAPOLIS, IA.—Articles of incorporation of the Mediapolis Telephone Company have been filed. O. H. Walker is general manager, and W. V. Lloyd secretary and treasurer.

MILTON, IA.—The Union Telephone Company has been organized. It will run from Milton to Keosauqua.

MT. PLEASANT, IA.—Another telephone exchange will be established here, a new company having been recently organized, with a capital stock of $50,000.

MOVILLE, IA.—The Moville Town Council has granted a franchise for a local telephone exchange to a syndicate of local business men.

RED OAK, IA.—The Red Oak, Salem & Hawthorne Mutual Telephone Company has been organized. Jacob Rose is president.

ROCK RAPIDS, IA.—The Lyon County Telephone Company, capital stock, $10,000, has been incorporated by W. C. Wyckoff, and others.

ROLAND, IA.—The Roland Mutual Telephone Company, capital $5,000, has been incorporated. E. Rice is president, H. E. Myran secretary and H. C. Deua treasurer.

WINFIELD, IA.—At a meeting of the stockholders of the Winfield Telephone Company $3,000 more stock was put on the market. This stock is to be sold for the purpose of building the lines southwest to Mt. Union.

TISHOMINGO, I. T.—Articles of incorporation have been filed by the Tishomingo International Telephone Company, capitalized at $50,000. Nack Wolfe, Ben J. H. Colbert, Cornelius E. Folly, Daniel M. Hailey and Leon H. Roberts are the incorporators.

WELLSVILLE, KAN.—A franchise was granted the Wellsville Telephone Company to establish and operate a telephone system in Wellsville.

BOREING, KY.—Mr. John Woodward has purchased the Pineville, Ga., telephone exchange and will connect it with the Barboursville system.

FRANKFORT, KY.—Articles of consolidation of the Old Kentucky Home Telephone & Telegraph Company, the Mt. Sterling Telephone Company, the Winchester Telephone Company and the Winchester and Lexington Telephone Company, which had a combined capital stock of $13,650, have been filed. The new company is to be known as the Old Kentucky Home Telephone & Telegraph Company and it has $100,000 capital stock.

LOUISVILLE, KY.—Postmaster Starks, at Hardin, Ky., is organizing a company to construct a telephone line from Paris, Tenn., to Paducah, touching at Hazel, Hardin, Murray and Benton.

PADUCAH, KY.—The People's Independent Telephone Company, capital $150,000, has been incorporated.

PARIS, KY.—A franchise has been granted to the Fayette Home Telephone Company, of Lexington. to operate an exchange at this place.

LAKE CHARLES, LA.—Captain C. J. Rauch is interested in establishing a telephone line between Leesburg and Lake Charles.

POCOMOKE CITY, MD.—The Telephone Company of Pocomoke City has been incorporated by Dr. William H. Waters, Emerson G. Polk, Isaac H. Merrill, William S. Schoolfield and Robert J. Lambdin. Extensive improvements and changes are being made in the exchange and on the line.

BOSTON, MASS.—The New England Telephone & Telegraph Company has purchased the Kearsarge Telephone Company, of Concord, N. H. The New England Company had previously purchased the Merrimac County Telephone Company, thereby eliminating all competition in Merrimac County, N. H.

ALMA, MICH.—The Union Telephone Company, at its annual meeting, elected the following officers: President, Stanley E. Parkhill, of Owosso; vice-president, J. P. Gibbs, of Ithaca; secretary, Thomas Brownley, of St. Johns; treasurer, G. L. Ward, of Alma. The capital stock was increased from $250,000 to $400,000.

DETROIT, MICH.—The Michigan Telephone Company has decided to establish an exchange at Milford.

DETROIT, MICH.—The Council has passed the ordinance granting rights to the Co-operative Telephone Company.

DETROIT, MICH.—The Valley Telephone Exchange, in this city, has grown to such proportions that the service is being handicapped by lack of facilities. New cables and switchboards will be installed.

DETROIT, MICH.—The Wayne Circuit Court has granted a mandamus requiring the Michigan Telephone Company to extend to the remaining subscribers of the Detroit Telephone Company, which was absorbed by the Michigan company, its full service and connections. For a time after the absorption the Michigan company extended its full service to the subscribers of the Detroit company. Michigan rates were cut to the same figure as charged by the Detroit company, and most of the subscribers to the latter company then put in Michigan telephones. Several months ago, when the Michigan company installed a new switchboard and raised its rates, the few remaining Detroit company subscribers were cut off from full service and given connections only with each other. The court holds that in buying out the Detroit Telephone Company the Michigan company bound itself to the terms and conditions of the ordinance under which the Detroit company operated.

MARQUETTE, MICH.—Manager Fred H. Smith, of the Michigan Telephone Company, says that his company is preparing to do a large amount of work on its lines in the Soo during the coming summer. Estimates on work amounting to $3,000 have been prepared, and if they are adopted by the company the work will be begun at once.

STOCKBRIDGE, MICH.—The telephone line between Trist and Munith has been incorporated for $2,000 under the name of the Trist Telephone Company. Andrew Reithmiller is president.

RENVILLE, MINN.—The matter of a farmers' telephone system is being agitated in Redwood County, and a committee is investigating the feasibility of establishing a system.

BOLIVAR, MISS.—The Bolivar Telephone Company has been incorporated with a capital stock of $10,000. Mr. Fred Clark is president; J. G. Collier, vice-president; D. J. Allen, jr., secretary, and W. T. Winston, treasurer.

JACKSON, MISS.—The telephone companies operating in the State will in future have to make reports of their property valuations for assessment by the Railroad Commission, as is done by other concerns, subject to the supervision of that body. This is rendered necessary by a law passed at the recent session of the Legislature, changing the method of assessing these corporations, which were previously left entirely to the county assessors. There are numerous local independent telephone systems in the State that will have to comply, but the system most extensively affected will, of course, be the Cumberland Company.

MERRILL, MISS.—The Merrill & Leakesville Telephone Company has been incorporated, with a capital stock of $500.

NEVADA, MO.—The Nevada Telephone Company, of Nevada, Mo., has been incorporated with a capital stock of $25,000, all paid up. The incorporators are A. B. Cockrill, L. M. Thompson, J. L. George and others.

BUTTE, MONT.—The Postal Telegraph & Cable Company has won its suit against the Oregon Short Line Railroad Company to obtain the right of way for a pole and wire line from this city to various points in Montana and to Oregon and Utah. The Postal Company has the right of way through Idaho and Utah.

KEARNEY, NEB.—A new telephone company has been started at Shelton, Neb., with a capital stock of $10,000, and to be known as the Farmers' Home Telephone Company. It is composed of the farmers in Shelton and Gibbon townships and will begin operations at once. The incorporators are William Smith, Albert Allen, Jacob Stearley, W. H. Maurer, and Joseph Buck, Jr.

OSCEOLA, NEB.—The Board of Village Trustees has granted a franchise to the Golden Rod Telephone Company, of Wahoo, to operate a telephone exchange in the village and to charge not more than $1.50 per month for business telephones and $1 for residences.

WEEPING WATER, NEB.—The City Council has granted franchises to both the Nebraska Telephone Company and the Plattsmouth Telephone Company. An exchange will be put in this spring.

NEWBURGH, N. Y.—The Citizens' Telephone Company, capital, $10,000, has been incorporated; directors, George Hardy, C. L. Wenzel, and G. R. Mitchell, of Newburgh.

REIDSVILLE, N. C.—The Reidsville Telephone Company has been incorporated, with a capital stock of $20,000, for the purpose of enlarging the Reidsville exchange and the building of several long-distance lines.

PILOT MOUNTAIN, N. C.—The Farmers' & Merchants' Telephone Company is building a six-mile line to Ararat.

WELDON, N. C.—The Bell Telephone Company will build a direct line between Huntsville, Ala., and Chattanooga, Tenn.

MANDAN, N. D.—The Mandan Telephone Company has been incorporated by C. E. V. Draper, Hattie Draper, P. Tobin and T. R. Brewer.

MINOT, N. D.—The Minot Light & Telephone Company has been incorporated by J. J. Barclay, F. C. Clark and L. M. Davis.

CANTON, OHIO.—Fifty-three of the sixty physicians here have boycotted the Bell Telephone Company. They have ordered their instruments out. The trouble started over an attempt to raise rates.

DEFIANCE, OHIO.—The Grocers' & Butchers' Association has declared war against the Central Union Telephone Company, because the company has announced an increase of rates for business and residence service.

FINDLAY, OHIO.—Manager Duval, of the Home Telephone Company, announces that the company is about to expend $60,000 in improvements.

JOHNSTOWN, OHIO.—The Johnstown Telephone Company has been incorporated, with $30,000 capital stock, by Dayton Bishop, C. W. Coe, Mark Coe, G. L. Beam and Dwight L. Sapp. The Johnstown & Croton Telephone Company, capital $30,000, has also been incorporated by C. H. Bishop, C. W. Coe, Mark Cook, Frank L. Beam and Dwight E. Sapp.

LODI, OHIO.—The Star Telephone Company will install additional instruments and string new cables in this place. A new exchange will be installed in the village of Spencer.

MARION, OHIO.—The Marion County Telephone Company has increased its capital stock from $5,000 to $10,000. Fred E. Guthery is president and Frank Crow secretary.

MOOREFIELD, OHIO.—The Moorefield & Caculli Telephone Company has been incorporated, with $2,000 capital stock, by J. S. Wallace, W. W. Kirkpatrick, S. J. Hanefeld, A. Blockburn, H. C. Wallace and E. D. Moore.

NEWTON FALLS, OHIO.—The Newton Falls Telephone Company is installing a new board built by the North Electric Company, Cleveland. The system will be improved.

NORTH LIMA, OHIO.—The Beaver Township Telephone Company has organized and will commence construction work in the near future.

SPRINGFIELD, OHIO.—The Common Pleas Court here has decided against the Central Union Telephone Company in a case where it attempted to remove a telephone because subscriber would not pay a higher rate than that usually required. The court held that the company had no right to discriminate in rates.

TROY, OHIO.—The Troy Home Telephone Company and the Piqua Home Telephone Company have gone into the American Home Telephone Company, which has recently been formed with $3,000,000 capital stock to combine plants in Richmond and Elkhart, Indiana; Troy, Piqua, Port Clinton, Tiffin and London, Ohio; Huntington, W. Va., and Herkimer and Rome, N. Y.

WAPAKONETA, OHIO.—W. H. Fledderjohann and others have purchased the exchange at Ada, Ohio, paying $50,000. The purchase includes the toll lines connecting the exchange. The same people have incorporated a company at Bellefontaine, Ohio, with $250,000 capital stock. When completed, the property will include exchanges in ten towns in that vicinity, with about 500 miles of toll lines.

GUTHRIE, OKLA.—The Missouri & Kansas Telephone Company is preparing to spend $1,000,000 this year to improve its system. Almost one-half the sum will be expended in Kansas City. The bulk of the balance of the money will be spent in Lawrence, Wichita, Topeka, Kansas and Oklahoma points. New buildings are to be put up at some places, and all are to be provided with more or less new equipment. At the same time, the company is going to extend as rapidly as possible its service to farmers and ranchmen. It has several hundred farm houses in Missouri, Kansas, Oklahoma and the Indian Territory, already connected up and its agents are at work increasing this part of the business.

SHAWNEE, OKLA.—The Long Distance Telephone Company, which was incorporated here last February, has 360 subscribers in Shawnee, 85 miles of toll line in operation and 180 miles in course of construction. Its rates are $2.50 per month for business subscribers and $3.50 for two residences. Mr. James F. Noble is president and E. D. Nims secretary and treasurer. The switchboard has a capacity of 400 lines, Kellogg, Stromberg-Carlson and Sterling apparatus being used.

HANOVER, PA.—The local telephone syndicate, composed of S. L. Johns, Harry N. Gitt, George D. Gitt and Thomas J. O'Neill, has purchased the lines of the Boyds Telephone Company, of Maryland. This syndicate now owns all the telephone lines in Northern Maryland and several in the Virginias and Southern Pennsylvania.

NORRISTOWN, PA.—The Montgomery Telephone Company, which was recently organized, contemplates making some early extensions to its system. Mr. J. H. Schultz is president and Amos H. Schultz secretary.

CHARLESTON, S. C.—The Southern Independent Telephone Association was formed here at a meeting of representatives of independent telephone companies from North and South Carolina, Georgia, Florida and Virginia. F. V. L. Turner, of Atlanta, was elected president; W. G. Barien, Tampa, vice-president, and Paul Langdon, of Augusta, secretary and treasurer.

HENDERSON, S. C.—Final connections have been made between Greenville and Kinston, giving long-distance service to Morehead City, via the lines of the Carolina and Virginia Telephone Company. The main line, constructed to complete this connection, is about 200 miles in length and is a double metallic circuit. It now extends from Chase City, Va., to Morehead City, N. C., affording direct communication with over 5,000 subscribers in 35 exchanges. The principal points reached by the line just completed are Rocky Mount, Greenville, Tarboro, Scotland Neck, Wilson, Washington, Ayden, Kinston, Dover,

Trenton, New Bern, Mayboro and Morehead City. A cable is now being laid from Morehead City to connect Beaufort with the system.

SIOUX FALLS, S. D.—A movement is on foot among the business men of Canistota to establish a local telephone system.

MEMPHIS, TENN.—The Memphis Telephone Company has increased its capital stock from $200,000 to $600,000.

SHARON, TENN.—The Cumberland Telephone & Telegraph Company has made a deal with the Weakley County Telephone Company which gives the former entire control of Sharon and Dresden, while the Weakley County Company will have control of Martin and Greenfield. All the Cumberland wires at Martin and Greenfield will run into the Weakley County boards, while all the Weakley wires at Dresden and Sharon will run into the Cumberland boards.

HILLSBORO, TEX.—The City Council has granted a franchise to an independent telephone company.

BEDFORD CITY, VA.—Arrangements have been completed for the establishment of a local telephone exchange by the Southern Bell Telephone Company.

LEXINGTON, VA.—Messrs. A. Elhart, Andrew Montgomery and others, of this place, are organizing the Rockbridge Mutual Telephone Company.

MARION, VA.—The Smyth Telephone Exchange has been incorporated here by S. W. Dickinson, president, and G. E. Goodell, secretary and treasurer.

RICHMOND, VA.—It is said the Chesapeake & Potomac Telephone Company will extend its lines from Washington County, Md., throughout Jefferson County, W. Va.

SMITHFIELD, VA.—The Smithfield and Isle of Wight Telephone companies have been consolidated under the name of the Home Telephone Company. Mr. J. W. Hollaway is president, A. S. Barrett secretary and treasurer and B. G. Gay general manager.

TACKETT MILLS, VA.—Mr. W. D. Reamy and associates will construct a telephone system at this place. The plans, however, have not yet been prepared. The contracts will be awarded later.

PROSSER, WASH.—The Prosser Telephone Company has been incorporated by Nelson Rich, D. M. Angus, John Chisholm, and W. P. Brownlow.

WHEELING, W. VA.—The area covered by the National Telephone Company is steadily increasing. Connection has been made with Akron, Ohio, and every town in Ohio within a radius of 150 miles. Bellaire will be connected within a few days when the enlarged switchboards are fully completed. A new line to Moundsville is under construction. All towns in West Virginia are now connected.

INDEPENDENCE, WIS.—The Osseo Telephone Company was granted a franchise to put in a telephone system at Fairchild.

ATHENS, WIS.—The Athens Telephone Company, capital $750, has been incorporated by Joseph Braun, George A. Kreutzer and William G. Cotansche.

KIRCHHAYNE, WIS.—The Kirchhayne & Cedarburg Telephone Company, capital $500, has been incorporated by William Fischer, sr., William Liesener and Henry Bartlett.

MILWAUKEE, WIS.—The Goodrich Transportation Company and the Barry Transportation Company are figuring to equip their fleets with wireless telegraph apparatus.

MUSCODA, WIS.—The Muscoda Mutual Telephone Company, capital $1,320, has been incorporated by F. E. Neff, H. J. Honer, N. F. Orth, Fred Kraus and James Sullivan.

WHITEWATER, WIS.—The township of Spring Prairie is to have a farmers' telephone system. It will be built by H. C. Hanckbey, president of the Walworth County Telephone Company.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Warrior River Light & Power Company has been incorporated by Robert R. Zell, J. L. Burns, A. L. Ezell, J. E. Adams and Charles J. Zell. The capital of the company is $1,000,000. This company proposes to erect a station on the Warrior River about twenty miles above Birmingham, and to utilize the water for the generation of power. The current will be transmitted to Birmingham.

EUFALA, ALA.—The City Council has under consideration two propositions for lighting the city, one from the local company with whom an agreement has not been reached, the other from the Atlanta Electric Light Company.

SELMA, ALA.—The plant of the Selma Electric & Power Company has been bought by W. D. and S. D. Pender and several Virginia and Pennsylvania capitalists. The price paid is between $75,000 and $85,000. W. D. Pender is already the president of the electric system in Norfolk and Portsmouth, Va., and Charlotte and Asheville, N. C., and has a large interest in the plant at Vicksburg, Miss.

REDDING, CALIF.—The Northern California Power Company has been formed, with a capital of $2,000,000, to absorb the Keswick Electric Power Company, of this city; the Redding Water Company, the Redding Electric Light & Power Company and the Tehama County Electric Light Company, of Red Bluff. The plant of the last-named corporation was recently nearly ruined by fire, but the lines of wire are all in good shape. The company will increase the present plant of the Keswick Electric Power Company, on Mill Seat Creek. There is at present machinery at the plant for the generation of 3000 horse power, with available water right for the utilization of 12,000.

SAN FRANCISCO, CALIF.—Henshaw, Bulkley & Company are installing the electric light plant at Fort Miley, San Francisco. The generating set consists of a 7½-kw General Electric marine type engine and generator.

SAN FRANCISCO, CALIF.—A complete electric light plant is in operation at the city water works, in Winnemucca, Nev. A flow of only eleven miner's inches of water is utilized under a head of 1150 feet to drive a 30-inch Pelton water wheel, direct-connected to a 75-kw General Electric generator. During the dry season the generator is operated by a steam plant.

SAN FRANCISCO, CALIF.—An electric power plant will be installed near Healdsburg, Calif., for the purpose of supplying lights for a new hotel and power for an electric railway. A dam will be built in the Russian River. The projector is C. K. Penover, a nephew of the late Calvin S. Brice. He has had plans prepared for a hotel and summer resort, on the summit of Fitch Mountain, two miles from Healdsburg. The electric road will convey tourists from the town to the base of the hill and a cog-wheel railway will carry the guests up to the level of the hotel.

SAN FRANCISCO, CALIF.—A force of men is at work in the Yosemite Valley, Calif., on the construction of the electric lighting plant that will illuminate the hotels and cottages. The power station will be located at the Happy Isles. From this point a three-mile pole line will follow the driveway to the hotel. Nearly 100 series arc lights will illuminate this road. Two 75-kw General Electric two-phase generators will be direct-connected to two double-nozzle Pelton water wheels.

SAN FRANCISCO, CALIF.—The electric transmission plant to be installed two miles north of Cloverdale, Calif., by a company organized by A. Sbarboro, of San Francisco, will soon construct its first section. It will supply electric light and power in Cloverdale and Asti. Two alternating generators will be operated under a head of 320 feet of water. Later on, the lines will be extended to Healdsburg, making the distance of transmission 22 miles. Preston and Geyseville will also be lighted from the plant, which will have a capacity of about 400 horse-power.

SAN FRANCISCO, CALIF.—The Grass Valley Consolidated Mine now has a complete electric system in operation. A Stanley 96-horse-power synchronous motor furnishes power for pumping and hoisting, both hoist and pump being belted. The hoist is operated by means of a reverse gear and friction brake. Electric lights and telephones are used throughout the workings. A 75-horse-power air compressor to be driven by an electric motor will be installed. Leon McHall, of San Francisco, is the consulting engineer. Current is obtained from the Nevada County power station of the Bay Counties Power Company's system.

LIVINGSTONIA, CENTRAL AFRICA.—This place is to be lighted by electricity. The cost of the machinery and its transportation to the mission was about $20,000. The only source of illumination hitherto has been kerosene, obtained at a cost, by the time it reaches Lake Nyassa, of $1.50 a gallon. Steam power being out of the question on account of the scarcity of fuel, the falls of the river Manchewe, near the mission, will be used for the driving of electric machinery. The machinery is now on its way. The natural waterfall will thus thrash wheat, grind the flour, and bolt it in the mill by day and at night give light to the people in their homes.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company has increased its capital stock from $70,000 to $90,000.

MILLEDGEVILLE, GA.—As a result of an order from the Superior Court, the noted Furman's Shoals property has been recently sold, the Oconee Electric Light & Power Company bidding in the property at $20,000. The shoals, which are said to be the third best water power in the State, are located on the Oconee River, about three miles above Milledgeville. An electric lighting plant will be built and factories will follow as a result of the development of this magnificent water power which has been heretofore running to waste.

BELVIDERE, ILL.—The citizens of Belvidere are asking the City Council for a franchise to install an electric light and heating plant. It is proposed to put it in on the most approved plans, and be up-to-date in every respect. The new company will be incorporated and will be known as the People's Electric Light & Heating Company.

CHICAGO, ILL.—The water power generated by the drainage canal will soon be used to furnish light to a portion of Chicago. The Economy Light & Power Company announces that a lease has been closed with the Edison Company by which 2,000 horse-power of that generated at the big plant at Jackson Street in Joliet would be furnished the Edison concern. Another lease has just been concluded with the Illinois Steel Company, by which 1,700 horse-power will be furnished the Joliet plant of that concern, and a third lease for 500 horse-power for the operation of the Bridgeport pumps has been signed.

FRANKFORT, IND.—A power plant is being built at the shops of the "Clover Leaf" Railway, in this city.

LEWISTON, IDAHO.—The electric power plant which supplies lights in Lewiston is being enlarged. An additional water wheel, having a capacity of of 650 horse-power, will be installed.

WELLINGTON, KAN.—The City Council has let the contract for an electric light plant for the city to the Hodge-Welch Electrical Engineering Company, of Kansas City, for $19,000, which is to be completed and in operation by July 10. The double unit system was adopted, using two 75-kw dynamos and two 110-horse-power Corliss engines. Sixty-four arc lights for street lighting and about 1500 incandescent lights will be supplied.

DONALDSONVILLE, LA.—The town is considering the advisability of using fuel oil for the municipal power plant. Sealed bids will be invited for the work.

ALBION, MICH.—A vote will be taken on April 7 on the question of issuing bonds for an electric light plant to cost $25,000. F. W. Culver is clerk of the Board of Public Works; James Shanley is mayor.

NEW BALTIMORE, MICH.—Noble, Moss & Company, of Detroit, have been awarded the $24,000 20-year bonds and $6,000 20-year electric light bonds.

KANSAS CITY, MO.—An ordinance has been introduced in the Council providing for an issue of $300,000 electric light bonds. If passed, the question will be submitted to a vote at the April election.

ALBANY, N. Y.—The East Creek Electric Light & Power Company, capital $200,000, has been incorporated to operate in towns of Herkimer, Fulton and Montgomery counties. Directors: Guy R. Beardslee, Ethel Beardslee, East Creek; Charles E. Snyder, Herkimer.

AMSTERDAM, N. Y.—The Shuttleworth Bros. Carpet Company is about to put in an electric light plant.

FULTON, N. Y.—The Fulton Light, Heat & Power Company has just been incorporated to furnish light, heat and power to Fulton, Oswego, Syracuse, Phoenix, Camillus, Clay, Cicero, Elbridge, Geddes, Lysander, Salina, Van Buren, Solvay, Baldwinsville, Jordan, Liverpool, Memphis and Warner.

COLUMBUS, OHIO.—The towns of Navarre and Caledonia, Ohio, are securing estimates on the cost of municipal electric lighting plants.

COLUMBUS, OHIO.—After several attempts the electrical contractors of Columbus have succeeded in forming an organization. Curtiss Claypoole is president and Harry Correll, secretary, of the organization.

DAYTON, OHIO.—The large market house and arcade to be erected in Dayton by E. J. Barney will be equipped with large engines, boilers, lighting plant, ice machine plant and six electric elevators.

MARTIN'S FERRY, OHIO.—Seasongood & Mayer have been awarded the $8,000 4-per-cent electric light bonds.

ATHENA, ORE.—The City Council of Athena, Ore., has granted A. Gillis a franchise for an electric lighting system.

BERWICK, PA.—The American Car & Foundry Company will build a new steel-car plant at Berwick, to be a duplicate of the plant recently built at Detroit. All machinery in the plant will be electrically driven, and labor-saving devices and machinery will be used. The plant will have a capacity of 10 to 20 steel cars a day.

HARRISBURG, PA.—The Waynesboro Electric Light & Power Company has decided to enlarge its plant.

ABERDEEN, S. D.—An electric lighting plant is to be installed by the Aberdeen Gas Company.

MEMPHIS, TENN.—The Oconee Electric Light & Power Company has purchased the property on the Oconee River known as Furman Falls, and will begin at once to develop the water power on a large scale. These falls are only a few miles from Milledgeville, Ga., and are able to furnish large power, being the third largest in the State. As soon as the power is developed, it is thought probable that an electric railway will be built connecting Milledgeville, the State sanitarium, the State prison, and Allen's Invalid Home. It is also stated that the power will be used for the operation of a large cotton factory near the falls. The men behind the enterprise are Milledgeville capitalists.

SALT LAKE CITY, UTAH.—The New Comstock Mining Company, of Mohave County, Ariz., will begin at once to erect a large power plant for the purpose of working a large ledge recently uncovered. A 500 horse power electric plant will be installed, to be operated by water power. The power will be derived from the Colorado River, a Walker endless-cable current waterwheel being utilized for the purpose. This wheel is operated by the river current directly, damming or diverting the water being unnecessary.

ESSEX JUNCTION, VT.—The Vermont Electric Company will build an auxiliary water-power station above its present plant. The new station will have a capacity of about 4000 horse power and will cost, approximately, $500,000.

DANVILLE, VA.—The Dan River Improvement Company has secured more than $800,000 of its stock, and the 15 per cent cash payment has been promptly met. It is probable that a syndicate will subscribe for the remaining shares, amounting at par to something less than $200,000. A large portion of the power will be used by cotton mills.

MANASSAS, VA.—An issue of $30,000 water, electric light and street bonds has been authorized by the Town Council.

HARPER'S FERRY, W. VA.—Mr. John L. Livers has secured the contract for the erection of an electric light plant in this place and will begin construction work on April 1. He will install a 75-kw Warren alternator furnished by the Rumsey Electrical Manufacturing Company, of Philadelphia.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—It is said that an entirely new system of street railways embracing Birmingham and outlying districts seems to be a certainty. The system will be built by the Steel Cities' Railway Company and Warrior River Power Company, which will be consolidated, with $2,000,000 capital. It is unofficially announced that arrangements have been made for floating the bonds.

NEW HAVEN, CONN.—Work has been begun on an addition to the Grand avenue power plant of the Fair Haven & Westville Railroad Company, which controls the trolley system of this city. It is being increased from a station of 2500 horse pawer to one of about double that capacity. By this improvement the company will be able to operate all its lines from one power house. The cost of the improvement will be $150,000.

SPRINGFIELD, ILL.—The Secretary of State has granted articles of incorporation to the Chicago & Milwaukee Electric Railroad, with a capital stock of $300,000.

KOKOMO, IND.—A new electric railway line is projected from this city to Brookston via Flora, Burlington and Delphi.

BRIGHTON, MICH.—R. B. Roberts, R. J. Lyon, G. W. Briggs, H. A. Nichols and others, of this place, are promoting a road to connect Brighton with South Lyon and Northfield.

JACKSON, MICH.—Contract for the completion of the electric railway between Jackson and Battle Creek has been sub-let by George E. Currie, of Detroit, to F. C. Lloyd, also of that city.

SAGINAW, MICH.—W. O. Bellaire, of Springfield, Mass., is here looking into traction interests. It is reported that he is arranging for a consolidation of the Saginaw Valley Traction Company, the Saginaw Electric Light Company and the Bay City Consolidated Street Railway Company.

SPARTA, MICH.—W. A. Waterhouse, of Boston, is interested in the construction of an electric railway from Grand Rapids to Newaygo and, it is claimed, construction work will start in the near future. The Newaygo Power Company will furnish power from its Croton dams.

NATCHEZ, MISS.—The board of directors of the Natchez Electric Street Railway have accepted the road from the contractors. Power is supplied by the Natchez Gas Light Company.

TRENTON, N. J.—The Hudson River Traction Company has been incorporated, with a capital of $1,500,000.

ALBANY, N. Y.—The New York City Interborough Railway Company has been incorporated, with a capital of $400,000, to operate surface street railroads in the borough of the Bronx. The directors are Robert C. Wood, William J. Fransioli, Thomas J. Bray, John H. Scoville, William B. Bryan, James Weeks, Philip Kearny, John E. Pinckney and L. C. Marston. The company, it is stated, will not be allied with Metropolitan or any other now in existence.

MOGADORE, OHIO.—The Akron-Alliance Connecting Railway Company has applied for a franchise through Mogadore.

COLUMBUS, OHIO.—Columbus people are securing right of way for a new electric railway, to extend from Columbus to Magnetic Springs by way of Dublin.

DAYTON, OHIO.—The Council at Troy has granted a franchise on Market Street to the Dayton & Troy Railway, making it possible for cars to operate in the center of the town.

BUCYRUS, OHIO.—The town of Shelby is endeavoring to induce the Buckeye Traction Company to build through that town. Practically all right of way has been secured by way of Sulphur Springs.

HAMILTON, OHIO.—The Millcreek Valley Railway Company is again blocked in its efforts to secure entrance to Hamilton. The mayor has vetoed the franchise on the ground that property owners asked him to do so.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Traction Company has placed a contract for the construction of a large portion of the line between Delaware and Marion, and work will start in the near future.

CLEVELAND, OHIO.—E. P. Roberts & Company, engineers for the Muncie, Hartford & Fort Wayne Railway, have awarded contracts for the erection of the power house, office building, car barns, repair shops, etc., to C. L. Briggs, of Cleveland.

SPRINGFIELD, OHIO.—Surveys have been completed for the Springfield & Wilmington Traction Company's line, the promoter of which is Harry Frey, of Springfield. He claims that the proposition has been financed and that construction work will start at once.

COLUMBUS, OHIO.—The Pomeroy, Rock Springs & Athens Railway Company has been incorporated to construct a line from Pomeroy to Athens, capital stock, $20,000. Incorporators: A. W. Lee, M. S. Webster, O. L. Bradbury, A. V. Howell, R. E. Stobert and Morton Webster.

ALLIANCE, OHIO.—The Akron-Alliance Connecting Railway Company has been incorporated, with $1,000,000 capital stock, by R. D. Gibby, New York; Hugh Bleakley, Charles S. Kieth, B. F. Weybrecht and Henry Shaffer, all of Alliance. The company will revive the projected Akron-Alliance electric line which was promoted several years ago. It is claimed Eastern capital has been secured.

CLEVELAND, OHIO.—The gross earnings of the Cleveland Electric Railway Company for February were $166,658.28, compared with $150,670.86 for the same month last year. The directors of the company have declared the usual quarterly dividend of 1 per cent, payable April 5. The matter of filling the vacancies on the directorate caused by the resignations of H. A. Everett and C. W. Wason was not acted upon.

CANTON, OHIO.—Officials of the Canton-Akron Railway Company met in Canton a few days ago. George W. Rounds was elected superintendent. The contract for a power house site in Canton was closed and the station will be built by the L. E. Meyers Construction Company. The same company was given a contract for extensive improvements to the Canton-Massillon Railway. It is believed the company will build the proposed line to Turkeyfoot Lake.

CLEVELAND, OHIO.—The Callinan Construction Company, of this city, has secured the contract for building the Indianapolis, Greenville & Shelbyville Railway. It will be 20 miles long, extending from Greenwood to Shelbyville, Ind. Entrance to Indianapolis will be secured under a 47-year contract over the Indianapolis, Greenwood & Franklin Railway. The chief promoters of the road are John F. Polk, Judge Hackney and Eugene A. Robinson, of Indianapolis. Contracts for material will be closed in the near future. It is not decided where the power house will be located. A contract has just been closed with the Ohio Brass Company for double trolley equipment.

DEADWOOD, S. D.—The City Councils of Deadwood and Spearfish and the Commissioners of Lawrence County have granted a joint franchise to S. W. Russell, James F. Summers and D. J. Toomey, to build an electric railway from the city limits of Lead, through Central City and Gayville to Deadwood, thence through the farming region of Centennial prairie to and through the town of Spearfish.

JACKSON, TENN.—The Jackson & Suburban Street Railway Company has purchased a number of new cars, and it is expected that considerable extensions will be made during the coming summer.

RICHMOND, VA.—The House has passed bills to incorporate the South Richmond Electric Railway Company, also the Newport News & Elizabeth City Railway & Electric Company.

LA CROSSE, WIS.—The La Crosse Street Railway Company is considering the construction of a line across the Mississippi to Pettibone Island Park.

NEW INDUSTRIAL COMPANIES.

THE EMPIRE WIRE COMPANY, New York, capital $100,000, has been incorporated. Directors: S. H. P. Pell, C. M. Garrison and R. T. Garrison, New York.

THE ELECTRIC CASH AND PARCEL CARRIER COMPANY, New York, capital $100,000, has been incorporated. Directors: E. S. Kelly, V. H. Cartwell and F. E. Holcomb, New York.

THE COLUMBIA TELEPHONE MANUFACTURING COMPANY has been organized at Ottawa, Ohio, with George W. Risser, president; William Reece, secretary and A. C. Hauck, treasurer. The above with C. H. Rice and W. F. Reed, of Ottawa, and Messrs. Mason and Nolan, of Chicago, are directors. A five-acre site has been secured as a location for the factory, which will be built at once. Temporary quarters will be selected and the plant will be removed from Chicago in the near future.

OBITUARY.

MR. D. H. DARLING.—We regret to note the sad fact that Mr. Daniel H. Darling, fifty-seven years old, a resident of Rye, died suddenly in a New York & New Haven train in the Grand Central Station, on the afternoon of March 26. Mr. Darling was the president of the United States Battery Company. He left his office during the afternoon to go to the station. On arriving, he entered a car and sat down. A few minutes later two of his friends, who were sitting near by, saw him lunge forward and slide off his seat. An ambulance was called from the Flower Hospital, but Mr. Darling died as the surgeon entered the station. Mr. Darling, who was well known and active in business, social and club life in New York City, had recently been engaged in some very important negotiations consolidating various storage battery interests.

PERSONAL.

THOMAS E. CLARK.

MR. THOMAS E. CLARK, of Detroit, the inventor of Clark's wireless telegraphy, briefly described in this issue, has been engaged in the testing of his system since October last. He has sent successful telegrams from a number of points to a number of stations. He has carried on a series of successful experiments, in all kinds of weather and at all times of the day and night. While he has met with considerable success, he has also encountered many difficult problems, which he expects to overcome. He has had stations working in Windsor, Ont., and in Detroit, and has received signals between Detroit and Windsor, Detroit and Belle Isle, Detroit and Wyandotte, Detroit and Toledo, and between Detroit and Cleveland made on the first trip of the *City of Detroit*, March 18. In regard to any reports that have gone out, the inventor says that he feels confident of the ultimate success of this system for marine purposes; and it will be a matter of only a few weeks before the system will be put in practical operation. Mr. Clark was at one time connected with the General Electric Company. He is the manager of the Electric Service & Appliance Company, of Detroit, and is the consulting engineer and manager of the electrical and construction department of the American Engineering Company, of Detroit, organized especially to develop his system for marine and railroad signaling and for general telegraphic work and for telephone purposes.

MR. C. A. COFFIN, president of the General Electric Company, has returned from his trip to England.

MR. FRED RECKENZAUN, consulting electrical engineer, etc., has removed his offices from 44 Pine Street, New York City, to the Washington Building, No. 1 Broadway.

MR. WALTER C. LUSK, formerly attached to the foreign department in the New York office of the General Electric Company, has been appointed as the company's representative in British India and the East, with headquarters in Calcutta.

MR. W. V. SWEETEN, for a number of years connected with the Western Electric Company, in New York and Philadelphia, has assumed the management of the sales department of the American Push Button Telephone Company, of New York City.

MR. W. K. PALMER, M. E., consulting mechanical and electrical engineer, New York Life Building, Kansas City, has been announced as consulting engineer for the Kansas City & Olathe Electric Railway, 18 miles in length, of which Mr. F. C. Goodwin, of Kansas City, is president.

MR. E. J. NALLY, general superintendent for the Postal Telegraph Cable Company, at Chicago, has contributed to the *Saturday Evening Post* an interesting article on telegraphy and its opportunities, addressed to young men beginning business. It is full of good points and good advice.

MR. J. ARTHUR AITON, of Aiton & Company, of London, is now in New York City, and will visit the cities of Boston, Philadelphia, Cincinnati, Chicago, Cleveland and Pittsburg. The firm is well known in connection with steam piping work in England, where its work is to be found in a number of large plants.

MR. BAILEY WHIPPLE, recently connected with the Buckeye and Jandus Electric companies, of Cleveland, Ohio, is now associated with the Sawyer-Man Electric Company, with headquarters at the well-known old works and general headquarters of the company, West Twenty-third Street, near North River, New York City.

MR. GEORGE E. DEAN, representing the Parke & Lacey Company, of Melbourne, one of the largest electrical and general supply houses in Australasia, is now in the United States, with a view to making agency arrangements with various American concerns seeking a market in the Antipodes. Mr. Dean is at present in the West.

COLONEL WATANABE, military attache at the Japanese Legation, Washington, has been instructed by his government to inspect several of the more important electrical engineering and manufacturing plants throughout the United States, with a view of placing contracts, especially for arsenal equipment, in the near future. Colonel Watanabe is at present in the West.

MR. BERNARD DRAKE, of Drake & Gorham, the well-known English electrical engineers, contractors, etc., has been visiting this country and left on Saturday last on the *Campania*. The above-named firm already handles several American specialties, being an alert and progressive house, and Mr. Drake having used his time to advantage, had the satisfaction of closing up various new arrangements before he sailed.

DR. F. A. C. PERRINE, the president of the Stanley Electric Manufacuring Company, has, it appears, been the recipient of a gold medal diploma from the Paris Exposition of 1900 as a "collaborator" with the Standard Electric Company, of California, of whose plant, with a transmission of over 200 miles, he was the electrical engineer, while in California as professor of electrical engineering at Leland Stanford Junior University.

MR. R. PERCY SELLON, of the Brush Electrical Engineering Company, Limited, of England has sailed for home, after a stay of about ten days in this country, chiefly in New York. Mr. Sellon is also a director in the Otis Elevator Company in England and has had, among other things, important work in hand with those interests here. He had not visited America in some years, and was very much pleased at the rapid progress made in the electrical industries during the interval.

MR. ALBERT B. HERRICK will be located in the West at the Algonquin Hotel, Dayton, Ohio, for the next five weeks in the interest of the Dayton & Troy Railway Company, Springfield Railway Company, Indianapolis Street Railway Company, Dayton Arcade Company, and the Friend Paper Company, National Cash Register Company and Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. He will also investigate the proposed Dayton & Germantown and Dayton & Lexington roads in the interest of capitalists. This work was offered him on account of his expert work for the street railways of Dayton, Ohio, in the electrolysis case.

MR. G. T. AMMON, who for some time past has acted as auditor at the Pittsburg offices of the Westinghouse Electric and Manufacturing Company, sailed last week for Europe for the purpose of assuming the accountantship of the British Westinghouse Electric & Manufacturing Company, one of the largest concerns of its class in England. While Mr. Ammon will be the head of the bookkeeping department, he will not be, in the American sense, the auditor of the British Westinghouse Company, as all concerns registered under the English limited liability acts are required to have their accounts audited by public accountants appointed by the stockholders in general meeting.

PROF. JOSEPH W. RICHARDS, of the Department of Metallurgy, Lehigh University, lectured on March 14 before the New York Electrical Society on the electro-chemical industries of Niagara. The attendance was large to overflowing, and the lecture was heard with deep interest by the large audience. Prof. Richards reviewed the work done at Niagara, the new industrial chemical center of the country, and pointed out that there, beginning with aluminum, eight different new processes had been worked out. The lecture was admirably illustrated with lantern slides. After the lecture, Prof. Richards was highly complimented by Dr. R. O. Doremus, who gave some characteristic reminiscences of early chemical work.

SAYLES—HOWLAND.—Miss Madeline Sayles, daughter of Mr. and Mrs. John E. Sayles, was married on Easter Monday to Harold J. Howland, son of William B. Howland, publisher of *The Outlook*. The ceremony took place at the home of the bride, on Orange Road, Montclair, N. J. The Rev. Mr. Hubbell officiated. The bride was attended by her sister, Miss Mary B. Sayles, and Miss Alice E. Egbert, of Montclair, and her cousin, Miss Esther Root, of East Orange, who was the flower girl. The best man was Karl V. S. Howland, brother of the bridegroom, and the ushers were Arthur H. Underhill, of Montclair, and Harry W. Matthews, of New York. The father of the bride was long prominent in Edison and General Electric affairs and is actively engaged to-day in the electrical field in New York City.

Trade Notes.

THE CONOVER MANUFACTURING COMPANY has moved its office and works from New York to Princeton Avenue, Jersey City, N. J.

REMOVAL.—The Pittsburg office of the Niles Tool Works has been changed from the Carnegie Building to the Frick Building.

THE BALKWILL PATTERN WORKS, of Cleveland, Ohio, are established in a recently completed factory especially designed for their work. They are prepared to produce patterns of any size and character on short notice.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing among its customers attractive pamphlets, descriptive of the Wurts and Garton lightning arresters. Those interested can obtain this printed matter upon request.

THE SONG OF THE COG.—Believing in the charm of music the N. P. Bowsher Company, South Bend, Ind., is sending out private mailing cards telling about its ready-dressed mill cogs, the subject being introduced by an appropriate couplet set to music.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, reports through Mr. J. J. Nate that it is enjoying a continually growing business. The factory has been running a double force working day and night for the last six months.

SECOND-HAND MACHINE TOOLS.—A list of good modern second-hand machine tools has just been issued in pamphlet form by the Garvin Machine Company, New York. It includes hand and engine lathes, milling machines, drill presses, forges, planers, presses, shapers, etc.

VIADUCT APPARATUS.—The veteran, Mr. A. G. Davis, president of the Viaduct Manufacturing Company, Baltimore, Md., reports that they are keeping up with the times in making central energy apparatus for its telephone customers, and making new forms of apparatus, including hotel sets, etc.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has established itself as the Western repository for many of the standard makes of wires. It has in Chicago stock for immediate shipment a full supply of Roebling's and American Steel & Wire Company's extra B. B., B. B. and special galvanized steel telephone wire.

WM. J. MURDOCK & COMPANY, Chelsea, Mass., report that the demand for the "Solid" telephone receivers has more than exceeded their expectations and all indications point to a successful year in this branch of the telephone industry. Circulars and booklet illustrative of the "Solid" receivers will be sent on application.

THE BUCKEYE ELECTRIC COMPANY of Cleveland, Ohio, has been putting a large amount of time upon the development of small candle-power lamps, particularly two and three-candle-power sign lamps and the regular four-candle-power lamp. It states that it is doing this in response to the increasing demand for small units.

MR. WILLIAM ROCHE, 42 Vesey Street, New York, is introducing a new dry cell, known as the U. S. Navy and Army Standard No. 5, for which is claimed an electromotive force of 1.52 volts and current 14 to 18 amperes. Mr. Roche states that it will not run down on the shelf in two years if kept out of the sun and in a cool, dry place.

THE STERLING ELECTRIC COMPANY announces that Mr. Frank B. Cook, formerly president, is no longer connected with nor interested in the company. The company states that it owns exclusive rights under which its entire list of unsurpassed apparatus is manufactured and will be glad to serve the telephone fraternity at the old stand as in the past.

THE WIRT ELECTRIC COMPANY, Philadelphia, Pa., has outgrown the quarters it secured last spring and is installing new machinery in an extension. Among other things which the Wirt Company is building are some very large field rheostats of the sectional tubular style which have an entirely new construction especially adapted to heavy duty and high voltages.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just completed an installation of its common battery, lamp signal, multiple switchboard for an equipment for 2,100 numbers at Houston, Texas; a 1,000-capacity board at Galesburg, Ill., and another at Lima, Ohio, and is just finishing a 1,000-number board at Peru, Ind. It also has contracts for similar equipments at Rockford, Ill., and Wichita, Kas.

THE FOSTORIA INCANDESCENT LAMP COMPANY, lamp and glass works, Fostoria, Ohio, main offices, Cleveland, Ohio, reports that it has succeeded in making great improvements in high candle-power lamps the past two or three months. It has been well known that high candle-power lamps have not relatively rendered as good service as the medium candle-powers. In view of this the improvement referred to above is notable.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., is moving into its new quarters, having purchased a factory of the Chapman Manufacturing Company during the past month. It will take it two or three weeks to get settled down, and it will then put some new devices on the market. Its new plant is finely equipped with track facilities, artesian well, etc., and everything required for an up-to-date manufacturing establishment. It will have about twice its former floor space.

THE CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York, reports business as exceedingly good just now, and sales of its "Monarch" stop are very satisfactory. This device is stated to be giving much satisfaction wherever used, protecting life and property from engine mishaps. Four of these stops have recently been installed in the Los Angeles Street Railway Company's power plant. Charles C. Moore & Company, of San Francisco, are the Pacific coast agents for the Consolidated Engine Stop Company.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, of Chicago, Ill., reports a heavy business furnishing high grade bridging telephones for country lines, where 20 to 30 telephones are placed on one single wire in multiple. It is stated that tests of this apparatus made by different telephone companies in many of the States have been extremely satisfactory, fully bearing out the guarantees made. The apparatus which is now mostly called for in this field is the 100,000-ohm generator, with laminated armature and 5-bar magnet.

BRASS GOODS.—The International Brass & Electric Company, 76 Beekman Street, New York, manufactures a very complete line of brass parts for electrical apparatus. In an illustrated sheet issued by the company the extent of this branch of its work is seen. In general the articles include connectors of every shape, switches, fans for fan motors, telegraph instrument parts and many other pieces of special design. The company does, besides, fine wire winding, gear cutting, press work, experimental work, brass turning of every description, etc.

THE CINCINNATI TOOL COMPANY, of Cincinnati, Ohio, has just issued to the trade its twelfth catalogue, a handsome brochure of 48 pages and cover, well illustrated, dealing with its popular and standard Hargrave specialties, etc. The reputation of its goods has been maintained by a careful system of examination in the processes of manufacture, and the majority of its product, such as hollow angles, screw and plug bits, plug cutters, screw drivers, etc., are each tried and tested before they leave the factory. The catalogue is interesting and useful in the variety and fullness of its data as to the various lines.

HUBBARD, HALL & COMPANY, 213 West Fourth Street, Cincinnati, Ohio, are prepared to take the agency of one or two additional manufacturers. They are representing at the present time Columbia incandescent lamps, Adams-Bagnall arc lamps, besides other specialties and have just closed the agency in Cincinnati for the Benbow telephone bracket. This bracket screws into the side of the desk, having a swiveled arm firmly supporting the telephone, which arm may be swung into any position desired, bringing the telephone around in front of the desk when in use or swinging back to the side of the desk, where it is out of the way when not needed.

POWER IN CLOUDS.—Those who are interested in water powers and electric transmission will find some striking pictures in *Country Life in America* for April, in the article on the cloudlands as photographed from the top of Mt. Tamalpais at sunrise by Otto Von Bargen. The number is particularly valuable for its information and timely suggestion about gardening, floriculture, fruit-growing and kindred subjects, as well as for its "calendar" and articles that chronicle the sports and pastimes of those who love the country. The end of the first volume is celebrated with the largest number yet published, and it evidences the splendid success that the publishers claim.

CORRESPONDENCE SCHOOL COURSES.—The latest issue of the handbook of the American School of Correspondence, Boston, Mass., describes in an interesting way the plan of the school for enabling mechanics and others to improve their education without taking time from their work. The school offers courses in mechanical, electrical, steam and textile engineering, instruction being given by mail. Several pages of the handbook, showing actual work done by students, are printed in two colors, the student's work in black and the instructor's corrections in red, giving an excellent idea of the method of teaching. A number of representative letters from manufacturers, students and graduates are published, including several from such distant places as China and New Zealand.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., in a pamphlet describes the operation of its automatic telephone system. Illustrations of the various styles of instruments, and switchboards of different capacities are shown. This automatic intercommunicating system has, it is stated, been thoroughly tested and gives perfect service day and night. It is designed for town, factories, mills, mines, warehouses, hotels, private residences, steamships and offices. Among the advantages offered by this system may be mentioned the ability to make connections by the person calling, and any number of conversations may be carried on simultaneously without interference. An illustrated article on this system is published on another page in this issue.

FAN MOTORS.—The latest production of the General Electric Press is a pamphlet on fan motors, which well sustains the reputation of that press for producing the finest examples of trade literature in this country. The illuminated cover, the title page, the various sub-title pages and the numerous head pieces can all be classed as artistic productions of a kind that are rarely met with in trade publications. In the 48 pages of the pamphlet more than a score of different fan motors are described and illustrated. The final pages are devoted to small induction motors for running large ventilating fans. Other recent trade publications of the General Electric Company are three "Flyers," one on 60-ampere plug cut-outs, another on rack insulators and a third on direct constant-current enclosed arc lamps.

WITH PRINCE HENRY.—An artistic thirty-two page souvenir entitled "1,500 Miles Over the New York Central Lines with H. R. H. Prince Henry of Prussia," from Chicago, via Buffalo and Niagara Falls, to Boston, Albany, West Point and New York, has been issued by the passenger department of that railroad. It is printed in four colors, contains nineteen half-tone illustrations, two maps and a beautiful title page, with an excellent portrait of the prince. The letter press is descriptive of the German immigration to America and our trade relations with the empire. It gives the itinerary and the most interesting events of the tour. A copy of this beautiful souvenir will be sent for four cents in postage, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

ELECTRIC CRANES FOR LOCOMOTIVE WORKS.—The Niles-Bement-Pond Company's crane department has been awarded the contract for the electric traveling crane equipment to be installed in the Rogers Locomotive Works, Paterson, N. J. There will be one crane having a capacity of 100 tons, fitted with a 5-ton high-speed auxiliary hoist. This machine is to be operated by six motors having an aggregate capacity of 400 h.p. The motors will be furnished by the Crocker-Wheeler Company. The span will be 60 feet. Two 25-ton cranes with auxiliary hoist of 5-ton capacity have also been ordered. The spans will be 60 feet 7½ inches and 58 feet 1½ inches respectively. Each of these machines will be driven by four Crocker-Wheeler motors representing 50 h.p. for each crane. The cranes are to be built at the old Philadelphia Engineering shops at Philadelphia.

THE AMERICAN PULLEY COMPANY, Philadelphia, Pa., is now making wrought steel pulleys in all sizes from six inches up to 42 inches in diameter. These pulleys are not only stronger than cast iron and wooden pulleys, but they weigh only about half as much, size for size, as cast iron pulleys. One feature which commends itself is the fact that each pulley can be readily separated into halves, so that it can be put upon the shaft without taking the shaft down. It grips the shaft firmly and in the smaller sizes no key seats or set screws are required. Furthermore, the same pulley can be bushed for shafts of different sizes, and for that purpose a complete stock of interchangeable bushings is constantly kept on hand by the factory and by dealers. The American Pulley Company has published an interesting booklet about the development of wheels

and giving full information about its pressed steel pulley. This book will be sent on application to any one interested.

THE GENERAL ELECTRIC COMPANY, in its Bulletin No. 4284, has issued a valuable compilation of the prices paid for street arc lighting in the United States, giving the rates which have prevailed during the past year and are generally still in force. The towns and cities enumerated are divided up by States, and the population is given with the number of lamps, style, amperes, watts, hours per year, cost of coal coal per ton, contract price per year, cost to city per lamp-hour, and the watts per hour for 1 cent, for open and enclosed arcs. It is stated incidentally that the number off cities using the direct current series enclosed arc is 73, while in 326 other places the series alternating enclosed is in use with constant current transformers. The relative gain of the enclosed over the open arc from 1895 to 1900 is also shown graphically. The decline in the demand for the open arc is quite extraordinary.

THE IROQUOIS MACHINE COMPANY has just been incorporated as a New York company, having been organized by Mr. W. W. Gibbs. The officers are Edwin A. Smith, president, who is a prominent banker in Providence, R. I.; W. W. Gibbs, vice-president and general manager, New York; Henry C. Babcock, secretary and treasurer, Providence, R. I. The principal office is at 150 Nassau street, New York. The company will manufacture new and improved wire drawing machinery, which it claims will materially reduce the cost of producing wire. It will also manufacture a full line of automatic and plain drop hammers, swaging machines, rolling mills, roller bearings and grinding machines. Having ample capital, it has purchased the plant and business of the Universal Machine Company, located at Providence, and rented a large additional building adjacent to the same. The purchase of this running plant, and the addition named, will insure to the company's customers prompt filling of their orders. The company states that it will erect a new factory building during the coming summer.

THE MICA INSULATOR COMPANY, of New York, Chicago and London, is now putting on the market its well known Empire brand of oiled cloths and papers in rolls of 50, 100 and 500 yards' length. It is also prepared to furnish it in any special length desired. An entirely new and original process enables the manufacturer to coat the material with two very evenly distributed coats of pure linseed oil. Experience has proven that pure linseed oil refined and treated by the M. I. C. process is superior as a coating for cloths and papers, to the substitutes which usually contain adulterations, and which in a very short time will harden and crack. Empire cloth will retain its high finish and rubber-like flexibility indefinitely and may be kept in stock a long time without any deterioratiton either mechanically or electrically. It is thoroughly dried before leaving the factory, and does not contain nor does it need any wax paper between the sheets to prevent them from sticking together. The manufacturer will be pleased to furnish samples, circulars and prices to any who may be interested.

THE LARGEST ORDER FOR PIPE COVERING ever placed has been secured by the H. W. Johns-Manville Company from the Pacific Coast Oil Company (practically the Standard Oil Company), which will lay about 280 miles of eight-inch pipe from Bakersfield to Point Richmond, on San Francisco Bay, to convey its oil to the coast. As the grade is very slight, pumping stations are necessary along the line. On account of the heavy nature of the oil it must be heated to a certain temperature before it can be pumped, and to maintain this temperature of the oil in the pipes between the pumping stations a non-conducting covering is necessary, and the H. W. Johns-Manville Company is to supply the 280 miles of covering for this purpose. The materials of which the sections of covering will be made require about 100 cars for transportation, while the covering, when ready for shipment to California, will fill 200 cars. The immense facilities of the H. W. Johns-Manville Company, at both its New York and Milwaukee factories make it possible for it to successfully handle an order of this magnitude, and a number of miles of the covering were in transit to Bakersfield within a few days after the order was received.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

695,900. SYSTEM OF DISTRIBUTION FOR ELECTRIC LAMPS CONNECTED IN SERIES; Murray C. Beebe, Pittsburg, Pa. App. filed Oct. 27, 1900. Relates to means for operating a number of Nernst lamps in series, either from a constant current or a constant potential circuit. The glowers are connected in series and the heaters are in shunt to the glowers or sets of glowers; there are two impedance coils for each lamp, one of which is connected in series and the other in shunt with the heater, there being a condenser in series with the lamps.

695,913. INSTRUMENT FOR INDICATING THE PHASE AND FREQUENCY RELATIONS OF ALTERNATING CURRENTS; F. Conrad, Wilkinsburg, Pa. App. filed July 12, 1901. (See Current News and Notes.)

695,928. REMOVABLE HEATER FOR ELECTRIC LAMPS; Marshall W. Hanks, Pittsburg, Pa. App. filed March 23, 1901. Provides simple means for so supporting a heater in proximity to the glowers of a Nernst lamp that the heater may be readily removed and replaced without disturbing the glowers. The heater is mounted on a non-conducting support in guideways in such a manner as to be easily removable therefrom.

695,937. ALTERNATING ELECTRIC CURRENT GENERATING AND DISTRIBUTING SYSTEM; B. G. Lamme, Pittsburg, Pa. App. filed July 31, 1896. (See Current News and Notes.)

695,938. ALTERNATING CURRENT MOTOR; B. G. Lamme, Pittsburg Pa. App. filed July 14, 1900. (See Current News and Notes.)

695,939. METHOD OF MAKING OXIDS OF TIN AND LEAD; C. S. Lomax, Everett, Mass. App. filed July 24, 1901. (See page 599.)

695,944. SYSTEM OF ELECTRICAL DISTRIBUTION; J. S. Peck, Pittsburg, Pa. App. filed May 18, 1901. Relates to a three-wire system from the direct current side of a rotary converter, the third wire being connected to the alternating-current transformers. In order to prevent the current flowing through the balancing conductor from magnetizing the transformer cores, each of the three converter transformers has two windings, which are connected to the armature of the converter and also reversely connected to the balancing conductor of the three-wire circuit; with this arrangement currents flowing through the balancing conductor will exert no magnetic effects upon the transformer cores.

695,946. HEATER WIRE SUPPORT FOR ELECTRIC LAMPS AND METHOD OF MAKING SAME; Henry Noel Potter, Pittsburg, Pa. App. filed June 20, 1900. Nernst lamp heater rods are formed of powdered quartz and a binder, then baked and afterward fused and drawn out.

695,947. FLUID PRESSURE ENGINE; C. Robinson, Edgewood Park, Pa. App. filed April 27, 1900. An automobile engine stop in which the centrifugal force of an over-speeding engine causes an arm to be thrown out to operate a circuit closer and thus energize a magnet, which cuts off the steam.

695,953. ELECTRIC TROLLEY; C. E. Smith, Fall River, Mass. App. filed Nov. 4, 1901. A retractive device which trips and lowers the arm when the trolley rises above the wire.

695,958. MUSICAL INSTRUMENT; W. G. Spigel, New York, N. Y. App. filed June 11, 1901. The instrument consists of one or more scales of glass goblets normally rotated by power and against which rubbing devices are forced by electro-magnets controlled by a perforated music sheet.

695,962. A SYSTEM OF ELECTRICAL DISTRIBUTION; Norman W. Storer, Edgewood Park, Pa. App. filed Aug. 30, 1900. A storage-battery regulating system. An auxiliary dynamo and a storage battery are connected to the line in series with each other; an exciter for the auxiliary dynamo has one field magnet winding connected in the main circuit between the auxiliary dynamo and the translating devices, and an opposing field magnet winding connected across the main circuit between the main generator and the auxiliary dynamo.

695,971. ELECTRIC MASSAGE APPARATUS; F. B. Turck, Chicago, Ill. App. filed Aug. 12, 1901. A rubber glove contains a spray and an electrode, which respectively communicate with a reservoir of liquid and a source of electricity, whereby the operator can simultaneously treat with a shower both electric current and frictional manipulation.

695,976. TELEPHONE-SELECTING DEVICE; W. D. Watkins, San Jose, Calif. App. filed May 11, 1901. (See page 600.)

695,988. ELECTRIC RAILWAY; G. T. Woods, New York, N. Y. App. filed Aug. 24, 1900. The invention relates to railways of the sectional conductor type and consists of means for energizing successively the conductor sections.

695,991. ELECTRIC SIGNALING AND CIRCUIT CONTROLLING APPARATUS; T. J. Zoeller, Nashville, Tenn. App. filed Feb. 9, 1901. A fire alarm system in which the circuits are constantly under test and in which instantaneous commutations of the circuits are obtained.

695,995. ELECTRICAL HEATING APPLIANCE; J. F. Bachmann and A. Vogt, Vienna, Austria-Hungary. App. filed Nov. 22, 1898. An electric resistance of cylindrical shape and composed of refractory, non-conducting material and a conducting material, adapted to fit into a hollow appliance such as sad iron. The outer surface of the resistance is devoid of conductive material to prevent short-circuiting through the appliance.

695,997. TROLLEY WHEEL RETAINER; A. D. Barton, Ravenna, Ohio. App. filed Dec. 3, 1900. A pair of rollers are spring supported immediately above the trolley wheel.

699,004. ELECTRIC METAL-WORKING APPARATUS; Geo. D. Burton, Boston, Mass. App. filed Feb. 23, 1897. A receptacle for containing the substance to be treated, has perforations in the bottom to admit the electrolyte and to permit the treated substance to pass out. The cover of the receptacle is provided with a slot, through which an electrode extends, the elecrode being in contact in the electrolyte with the substance treated.

696,017. CONTROLLER FOR ELECTRIC MOTORS; E. F. Dutton, Schenectady, N. Y. App. filed Aug. 9, 1901. The controller is applied to motors used for revolving the turrets of war ships. The turret is provided with a tappet, which, at a predetermined limit of movement, trips a switch which opens the motor circuit and short-circuits the motor through a braking resistance.

696,023. ELECTRIC RAILWAY; E. W. Farnham, Chicago, Ill. App. filed Sept. 23, 1901. Relates to a system in which the conductor sections are movable to close their own circuit, and consists of the means for mounting such sections.

696,024. ELECTRIC RAILWAY; E. W. Farnham, Chicago, Ill. App. filed Feb. 6, 1902. Mechanism to be actuated by the movement of a movable rail to place the rail in electric communication with the main conductor.

696,053. ELECTRICAL PRESS; O. Kammerer, Charlottenburg, Germany.

App. filed May 19, 1900. A press operated by an electric motor and provided with a circuit interrupter, which is automatically actuated when a certain pressure has been reached.

696,055. CURRENT-LIMITING DEVICE; Samuel L. G. Knox, Schenectady, N. Y. App. filed July 31, 1901. At the bottom of the shaft of an electric railway controller is keyed a disk with a wide circumferential bearing. A shoe, adapted to engage with the surface of the disk, is normally kept from contact by a spring; when, however, too much current is passing through the controller an electromagnet causes the shoe to engage and stop the further motion of the controller in the same direction; the mechanism of the shoe is such, however, that the controller at any time may be turned in the opposite direction.

696,065. AUTOMATICALLY CONTROLLED RHEOSTAT FOR USE IN ELECTRIC MOTOR CIRCUITS; H. L. Miller, Pasadena, Calif. App. filed Nov. 7, 1901. Details of a liquid rheostat.

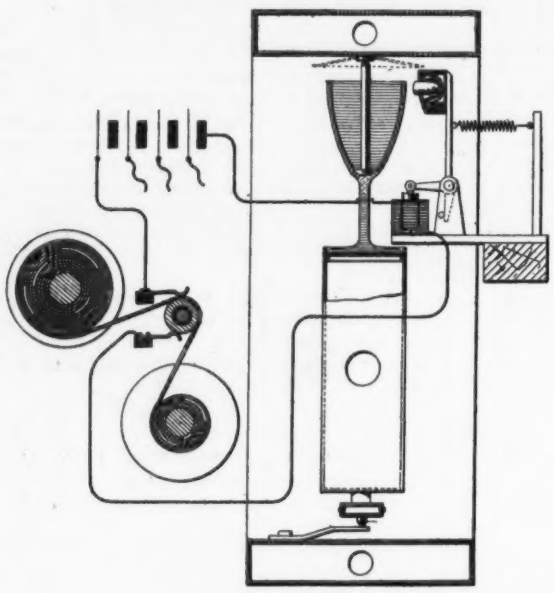
696,072. CONDUIT AND CONDUCTOR; P. A. McGeorge, New York, N. Y. App. filed July 13, 1901. A wedge is forced into the conduit by a device on the car and causes certain swinging arms to make contact with the main and return conductors in the conduit.

696,080. CONNECTOR FOR SPOOLS OF DYNAMOS; H. G. Reist, Schenectady, N. Y. App. filed Aug. 30, 1901. The connector consists of a light flat tube having a stiffening web.

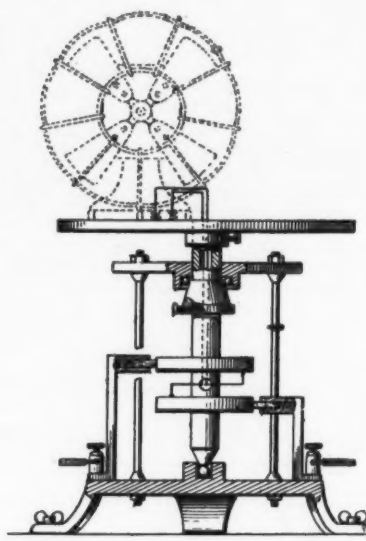
696,100. INCANDESCENT LAMP; P. M. J. Juge and A. E. Grisel, Paris, France. App. filed Sept. 8, 1900. The base of the lamp is entirely of glass and moulded into a screw-thread to receive a metallic thimble, enabling it to properly engage with a socket.

696,108. ELECTRIC GAS LIGHTER; C. A. E. Ruebel, St. Louis, Mo. App. filed Aug. 9, 1901. One of two burners, placed side by side, is equipped with sparking terminals; the gas at one burner is first lighted by the spark, then the second burner is ignited from the first, after which the first burner goes out, thus leaving the terminals cool.

696,109. APPARATUS FOR THE MANUFACTURE OF COMPOUND WIRE BARS BY ELECTRO-DEPOSITION; R. D. Sanders, Blackneath, Eng. App. filed July 1, 1901. (See page 601.)



695,958.—Musical Instrument.



696,191.—Turntable for Motor Fans.

696,117. APPARATUS FOR INDICATING AND RECORDING ELECTRIC PRESSURE AND CURRENT; W. Thomson, Netherhall, Scotland. App. filed Oct. 29, 1900. The instrument consists of a plurality of double sectors converging toward one another, causing them to be brought together at one of their sides, and a marking device secured to the sides of the sectors.

696,140. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Sept. 29, 1884. A number of instruments on the same circuit are so constructed that if one is set, all the others beyond it are cut out of circuit either automatically or by hand, so that no instrument can be released to transmit its signal until after the release of all those that may have been set that are nearer the station.

696,144. CIRCUIT TESTER; A. De Khotinsky, Chicago, Ill. App. filed Aug. 1, 1901. An arm is adapted to trail over the terminals of a series of circuits and automatically test one after the other of said circuits, a record being automatically made of each test.

696,157. ELECTRODE FOR SECONDARY BATTERIES; Auguste Henri Bainville, Nanterre, France. App. filed Dec. 30, 1901. The electrode consists of a central rod, provided with radiating longitudinal plates approaching each other at intervals, the whole being enclosed by a tubular jacket of the same material; the radiating plates are pressed together at several points to form cells for the active material.

696,161. AUTOMATIC TELEPHONE SYSTEM; J. J. Brownrigg and J. K. Norstrom, Chicago, Ill. App. filed Dec. 26, 1900. (See page 600.)

696,169. DEVICE FOR CLOSING AND INTERRUPTING ELECTRICAL CIRCUITS; S. Gleizes, Paris, France. App. filed Aug. 1, 1900. A switch for electric signs, consisting of a prism connected to one pole of the source, and upon the surface of which pattern cards are carried, which are perforated to allow spring fingers to make contact with the prism at various times to produce certain configurations on the sign.

696,171. SECONDARY BATTERY; Robt. H. Hassler, Indianapolis, Ind. App. filed Dec. 10, 1900. A grid has a series of groups of primary ribs and grooves or corrugations, the edges of each group being struck in opposite directions. By this means adjacent groups are separated along their edges, forming openings, and the units of active material on opposite sides of the plates are united to each other through the openings between adjacent groups.

696,172. CIRCUIT BREAKING DEVICE; A. J. Higgs, Colton, Calif. App. filed Dec. 22, 1900. Details.

696,179. ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed March 7, 1901. Details.

696,180. ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed March 18, 1901. A push-button switch, which requires releasing by means of a key before it can be operated.

696,191. TURN-TABLE FOR MOTOR FANS; N. M. Powell, Quincy, Ill. App. filed Aug. 27, 1901. The fan is placed at any desired location between the center and edge of a turn table and the resistance of the air to the motion of the fan causes the table to rotate.

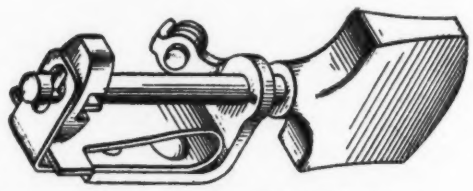
696,198. AUTOMATIC GRAVITY SIGNALPHONE; E. E. Salisbury, Chicago, Ill. App. filed Sept. 20, 1901. (See page 600.)

696,209. ENVELOPE FOR BATTERY ELECTRODES; Elmer A. Sperry, Cleveland, Ohio. App. filed May 22, 1901. Spun pyroxylin threads are woven into bands, which are then applied to a storage battery plate, being laid back and forth in a plurality of layers. Between plates thus served a corrugated perforated separator is placed, made of some material which is resilient as well as non-conductive, such as hard rubber.

696,213. ELECTRICAL CONNECTOR; G. B. Thomas, Hartford, Conn. App. filed Jan. 9, 1902. A thimble is placed over the end of the conductor to prepare the same to be inserted into a rail or other conducting body.

696,220. COMBINED EASEMENT AND POINT PROTECTOR; C. O. Anderson, Los Angeles, Calif. App. filed Sept. 7, 1901. A protecting plate to be applied to trolley wires at the ends of splicing sleeves and similar obstructions to prevent damaging the sleeve by the blow of the trolley wheel.

696,237. CONTROLLER FOR ELECTRIC RAILWAYS OR VEHICLES; J. C. Henry, Denver, Col. App. filed Dec. 14, 1899. In a series-parallel controller, where the fields and armatures are ordinarily connected in series, contacts arranged for disconnecting one of the motors from the circuit and connecting its field in parallel with the field of the other motor and subsequently connecting its armature to the circuit in parallel with the other armature.



696,261.—Incandescent Lamp Socket.

696,238. ELECTRIC CLOCK; M. Hoeft, Berlin, Germany. App. filed July 18, 1899. Details.

696,247. MULTIPLE CONTROL SYSTEM; H. W. Leonard, New York, N. Y. App. filed Jan. 24, 1901. (See Current News and Notes.)

696,261. INCANDESCENT LAMP SOCKET; H. T. Paiste, Philadelphia, Pa. App. filed April 16, 1901. The spindle carrying the circuit bridge-piece works in a loose bearing at one end to permit the spindle to adjust itself between the two terminals to afford equal contact with both.

696,313. ELECTRICALLY CONTROLLED RAILWAY SWITCH; R. V. Cheatham, Louisville, Ky. App. filed Dec. 5, 1901. In this switch it is not necessary for the motorman to know the position of the switch tongue, inasmuch as, to continue traveling along the main line, the current should be cut off at the controller, and to go on to the branch the current should be left on.

696,330. SIGNALING APPARATUS; H. H. Grenfell, Alverstook, Eng. App. filed Aug. 5, 1901. A rotating drum carries on its surface a number of orders or signals, any one of which can be moved into view from a distance by opening and closing a circuit to impart a step-by-step motion to the drum.

696,372. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Nov. 11, 1886. The transmitter can be set to transmit any one of various signals and will commence to operate when it is released from a distant point where the signal is desired. After the transmitter begins to work, no change can be made in the nature of the signal.

696,380. ELECTRIC GLOWER LAMP; Henry Noel Potter, Gottingen, Germany. App. filed Aug. 9, 1899. Relates to the use of a stationary heater below the glower of a Nernst lamp, and a plurality of translucent globes surrounding the glower and heater, whereby the casting of shadows about the heater is substantially avoided.